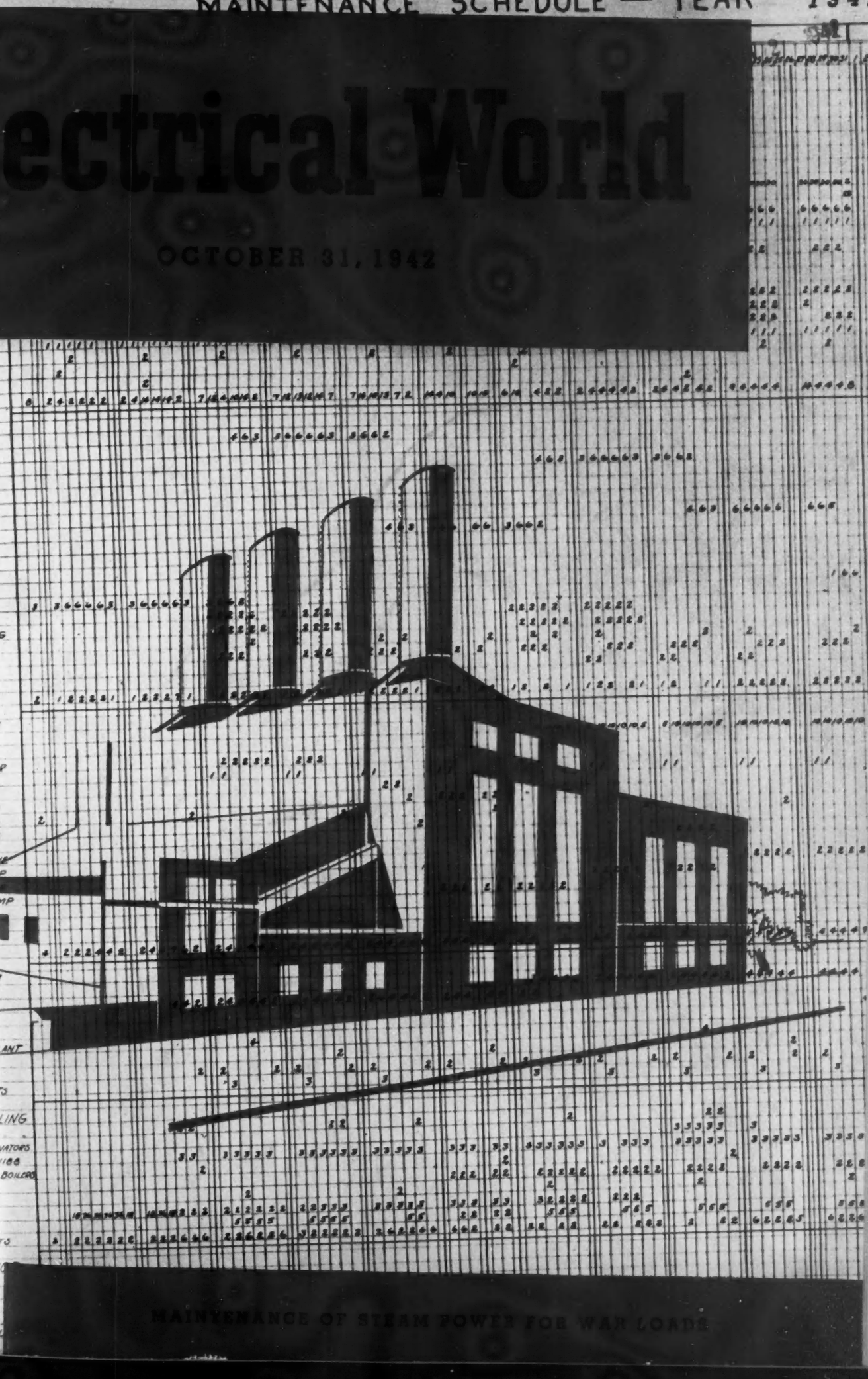
Electrical World

OCTOBER 31, 1942



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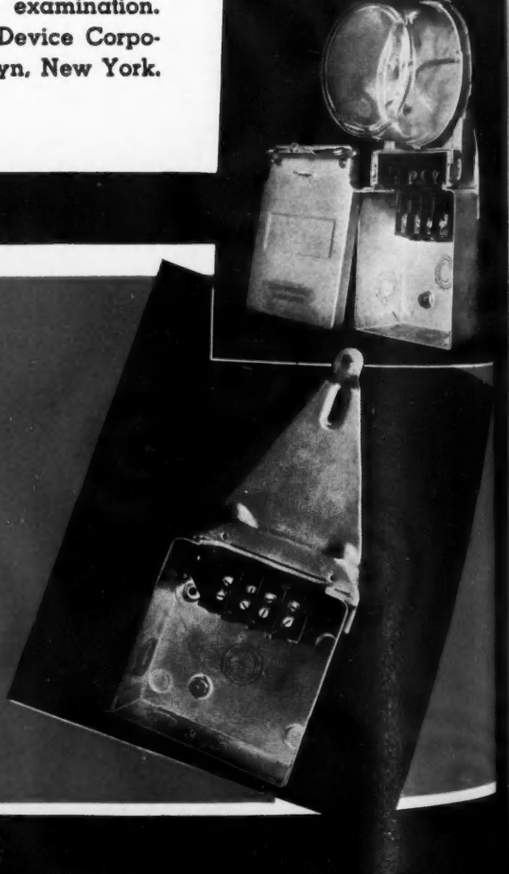

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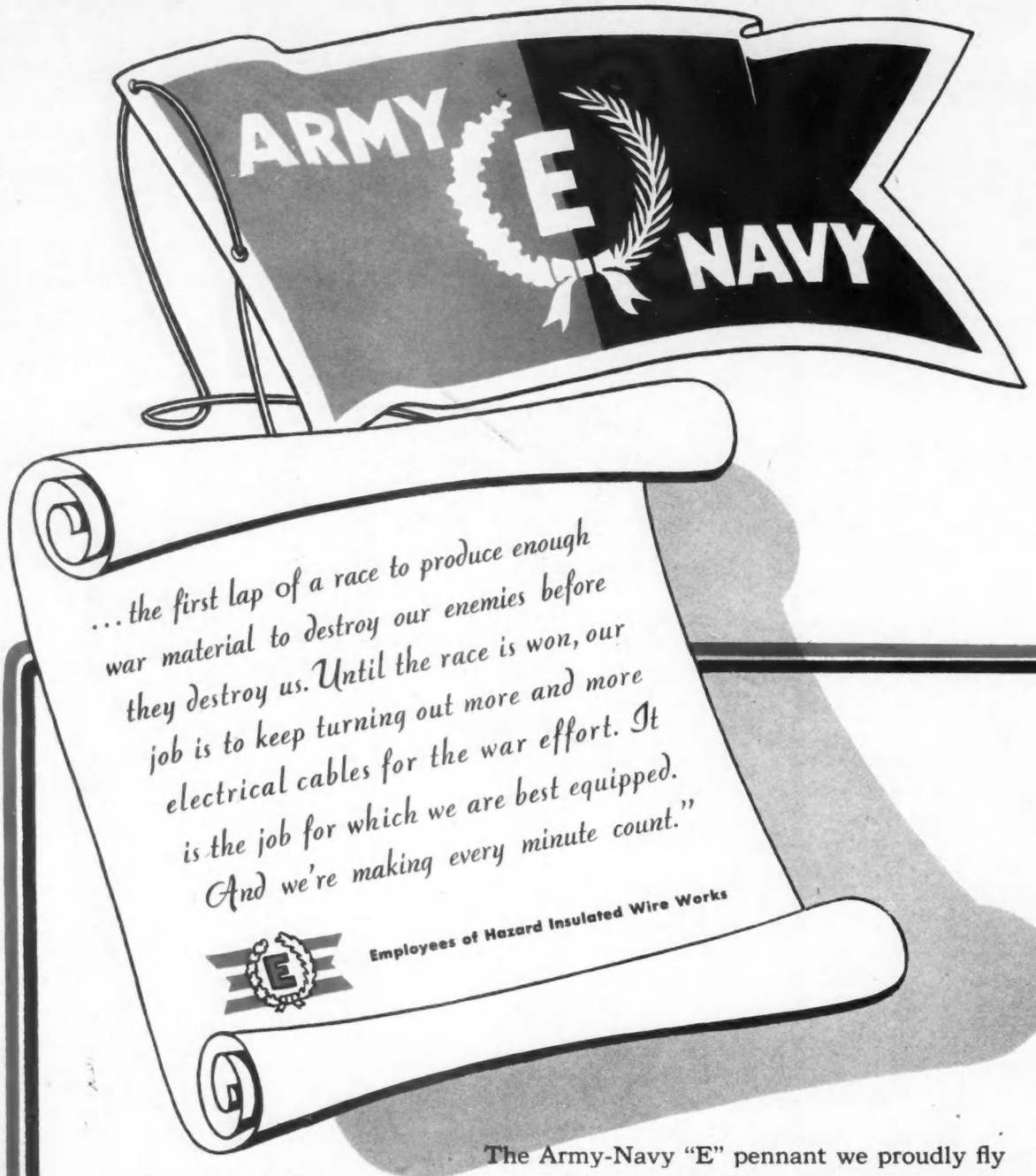
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Maintenance of Steam Power for War Loads

The honeymoon of ordering new generating capacity is over and even much of that which had been ordered has been withdrawn by WPB from manufacture. Thus the day of preparation for war's demand for electricity is fast coming to a close.

In this preparation the central station industry has every reason to be proud of its achievement in keeping ahead of load while industrial demand leapt forward. But from now on, except for the limited number of approved turbines now being built, the industry will not be able to rely on new equipment to carry the new load.

Even the substantial reserve that has always been available to carry over the peak, if something were to happen to the largest unit, is gradually being cut down, so that before this thing is over there will be little of the old type of capacity insurance for service continuity left. Utilities must henceforth get along with what they have.

There is every reason to believe that there will still be enough capacity if we can be sure that it will all be available as and when needed. However, it will be of no avail to point to the job of preparation if the capacity cannot turn out kilowatt-hours as needed. The Southeast had ample hydro kilowatts a year ago, but these weren't of much use when the ponds dried up.

The problem from here on, therefore, is not how to get more generating equipment but rather how to keep available for the load all of the capacity that has been created. Just as more new capacity seemed the big thing a year, two years ago, when we were planning for this output, maintenance has now become the most important element in today's program.

Central stations have always done a good job of maintenance, but it has been under conditions of greater reserve, less continued demand, shorter load duration and unlimited materials and trained personnel. In 1929, for instance, the kilowatt-hours per kilowatt of steam capacity were 2,796, last year they were 3,855. This year they will undoubtedly go well over 4,000, and next year even higher.

The new equipment should be able to take it without any trouble, but a considerable part of today's and tomorrow's burden must fall on older equipment—equipment that has never been pushed as hard as it is now and is going to be. It, too, will take it, but it will need care and attention.

Some of the current maintenance problems will lead to solutions by substitutes and what in normal times might be called makeshifts, but other methods will come out of today's necessity that will be sound at any time. Moreover, there will come a new understanding of the performance ability of well-designed equipment which may greatly affect future operations.

That, however, is for the future. For today the job is to keep the fires a-burning and the kilowatts a-turning. When the present supply of new kilowatts comes off the factory floor there may be no more. We must learn to do with what we have. Maintenance is king today.

Coordination of Unit Overhaul Periods

Principles, operating criteria and experience guides to inspection and overhaul programs which assure most advantageous timings of outages and margins of load capabilities

PHILIP SPORN, Vice-President and Chief Engineer American Gas & Electric Service Corp.

OPERATION of electric power systems in wartime is taking place with plants loaded closer to maximum capabilities than ever before. Hence, the operation is resulting in the availability of lesser reserves than ever. This is as it should be; in fact, it is a definite duty under war conditions to operate with reserves as close to zero as possible. But operating on such a basis, this may go further; reserves may from time to time slip below the zero line and become negative. Under such conditions, knowing the stress to which equipment will be put, it is more than ever important to maintain equipment properly, and particularly to set up carefully considered scheduled programs of major maintenance and overhauling.

Scheduled Outages

In carrying out such a program in peacetime each system can perform and operate on the basis of its requirements and its own experience. In wartime, however, it is necessary to go farther and incorporate not only other available experience, but as many new ideas as possible and, particularly, broad major area coordination. The object of all of this is, obviously, to obtain maximum utilization of existing installed capacity. It is necessary to re-examine previous ideas as to (1) the frequency of scheduled outage periods, (2) the time when such outage is to take place, and (3) the duration of each period, in order to accomplish the necessary and indispensable maintenance and overhaul.

Of the three main pieces of major equipment in a steam-electric power plant, namely, the boiler, turbine-generator and condenser, the turbine was commonly considered most critical from the standpoint of effect of the carrying out of periodic, or scheduled, maintenance on plant or system capability. This may have been the case once when it was not uncommon practice to have boiler capacity in a steam-electric plant provided by a group of boilers which always included some spare capacity, so that boiler maintenance generally did not reduce plant capability, as long as the turbine was ready to run. But that practice has been to a considerable extent discontinued in most modern plants, and total steam generating capacity and turbine capability are so closely balanced that the loss of any boiler, or a reduction in steam generating capacity, will invariably result in a reduction in unit or plant capability.

This has brought about the condition where the boiler, in general, is more critical than the turbine from the standpoint of plant or system capability. The surface condenser—at least those installed in any well-designed plant—has usually been the source of minimum disturbance to the continuity of plant or system capability. However, regardless of

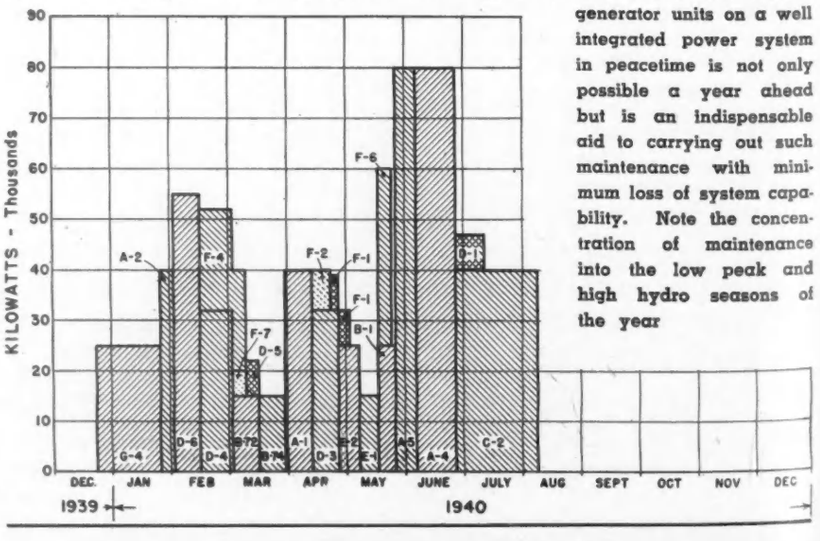


FIG. 1—Advance planning of a program of coordinated major overhaul of steam-electric generator units on a well integrated power system in peacetime is not only possible a year ahead but is an indispensable aid to carrying out such maintenance with minimum loss of system capability. Note the concentration of maintenance into the low peak and high hydro seasons of the year

the relative position on the scale of influence on continuity of system capability of the three major pieces of equipment, it is clear that the object of scheduled outage for overhaul and maintenance is, or should be, to carry out the replacements of all parts that have been exhausted by wear and tear since the last general or extensive maintenance was carried out, or to carry out those preventive changes that are likely to interfere with the operation of the unit continuously and uninterruptedly until the next scheduled outage can be arranged for.

This, in effect, means that some criterion of availability must be set for each of the three pieces of equipment, and that the equipment will be put into such shape during the scheduled, or periodic, overhaul outage that, except for unforeseen contingencies, there will be reasonable assurance of its staying in continuous service for the entire scheduled period.

Frequency Criteria

To attain the above ideas as the fundamental objectives, how frequently should a boiler be scheduled for outage and what are the determining, or governing, conditions? It is obvious that this depends to a considerable extent on (1) the design of the boiler, (2) the type of fuel that it burns, (3) the performance of the boiler under that type of fuel, and (4) to a great degree on the handling to which the boiler is being subjected.

But, assuming that the initial operating difficulties, if any existed, have been overcome and that the boiler has settled down to a steady diet of generating its rated steam output, and that it has received all the reasonable, intelligent care to which it is entitled, that improper slag accumulations have not been permitted either in the furnace or in the heat transfer portions of the boiler, even under those conditions experience indicates that the best operating boiler should be taken down for a major inspection and overhaul at least once a year. Then, during that period, if the boiler is thoroughly gone over and put into shape from breeching to economizer right down to the ashpit, it may be possible for the boiler to be able capably and continuously to perform for a period of 50 weeks, or if the boiler doesn't quite come up to a 96 percent availability record on that kind of program, the enforced outages in the intervening period should generally be of a short enough duration so that the total elapsed outage for the year will not be in excess of between eighteen and twenty days. During the period of assumed continuity of 50 weeks the boiler and its auxiliaries are bound to give, and will generally give, ample indication, cumulative as the 50-week period approaches its end, of need for thorough and complete overhauling.

Increase of fan power, plugging or bridging of intermediate water-wall or economizer surface, breakdown or break-through of baffle surface, possible indications of spots of high wall temperature, furnace floor or ashpit deterioration, mill liner wear and tear—these and numerous other indications of steady operation will inevitably accumulate. No one of these by itself generally furnishes an adequate cause for scheduling boiler outage at times when capacity is critical, but collectively they gather sufficient momentum to offer serious jeopardy to further assured continuity of operation.

A period of planned or scheduled maintenance, with every phase of the work properly organized, with each item of material on the spot, ready to be installed in its particular place in the boiler system, will produce that necessary replacement of worn life so indispensable to the ability to continue to perform on a plane of high reliability or availability.

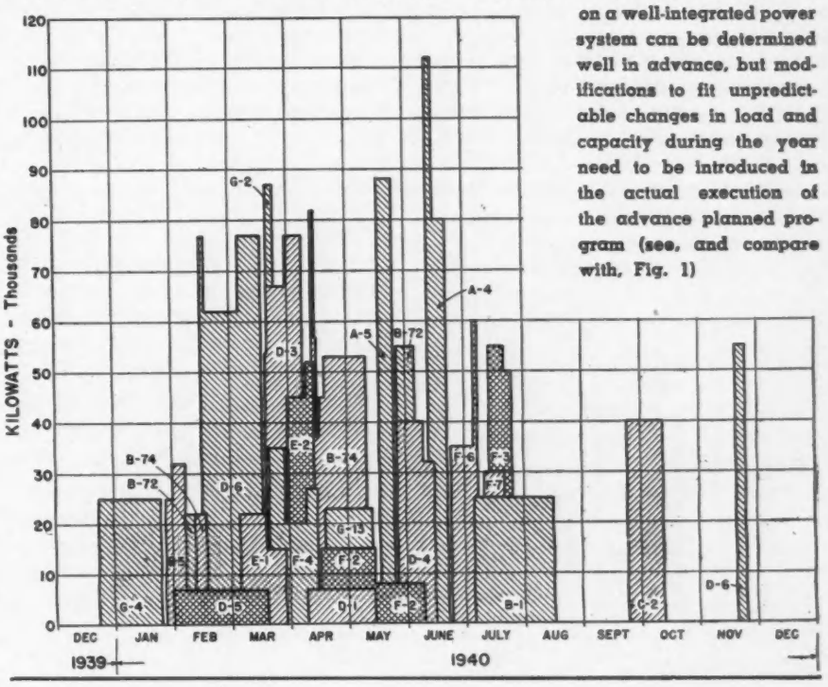


FIG. 2—The broad pattern of handling major overhauls of steam-electric generating units on a well-integrated power system can be determined well in advance, but modifications to fit unpredictable changes in load and capacity during the year need to be introduced in the actual execution of the advance planned program (see, and compare with, Fig. 1)

Turbine Inspections

The steam turbine plays, of course, a major part in any program of outage for scheduled overhauling. The time is not so far back when it was considered desirable to open and overhaul a steam turbine once every twelve months, or after approximately 8,000 hours of operating time. The irrationality of that, however, has been recognized now for some time, and most power plant operators have not only lengthened out that time, but are satisfied that they are able

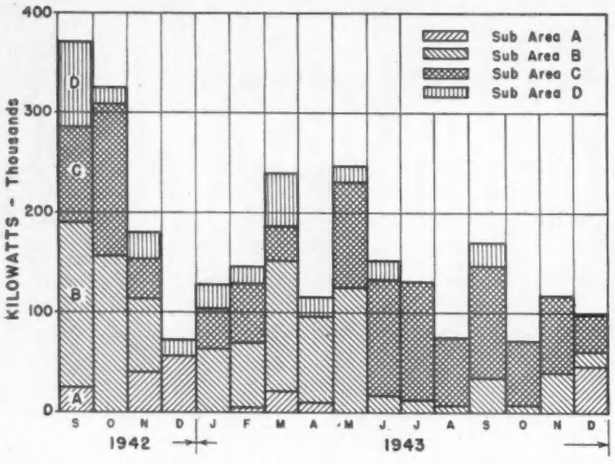


FIG. 3—The coordinated advance planning of a contiguous group of power areas is even more necessary in wartime. Because of much diminished reserves and continually changing relations between load and capacity growth, the normal seasonal factors may have to be given relatively minor weight in determination of planned capacity outage curve (see Fig. 4)

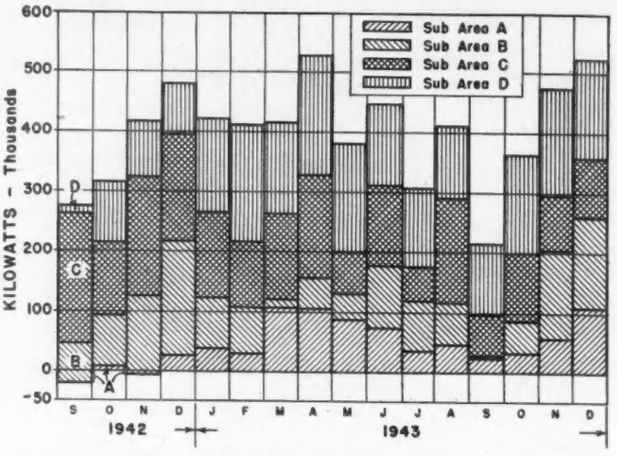


FIG. 4—A well-coordinated wartime program of planned major capacity outage for overhaul on a group of contiguously located power areas will be so set up that in so far as possible each area will show at all times a relatively proportional amount of capacity as reserve for unplanned outage and load growth and for spinning reserve

Note, too, in Fig. 4 the comparatively steady level of total reserve and compare with the relatively widely fluctuating level of total capacity outage in Fig. 3

to do that with no detriment either to the turbine or to continuity of service. This has been carried to the point where, with intelligent watching, many operators today believe it entirely safe to run turbines, unopened, up to periods of as long as 25,000-35,000 hours.

It is true that this cannot be carried out without the use of intelligently planned instrumentation. However, if such aids to sound operation as continuous eccentricity and vibration recorders are used, if stage pressures, and particularly stage pressure differentials, are watched carefully, if power capability of the unit or steady decrease in capability where that occurs is watched, and remedial measures, such as washing, that are now available to the art, but falling considerably short of opening up of the turbine, are taken, then the period between necessary opening of the turbine can be extended to the 25-35,000 hour band mentioned previously.

In connection with loss of power, it is particularly necessary to draw a line of demarcation between loss of power due to accumulation of deposits and plugging of nozzle and blade passages, and gradual loss due to wear of packing, and diaphragms, or partial or even entire loss of blading. It is obvious that the latter can in no case be compensated for, except by eventual replacement of the lost or worn parts. The former, however, can be taken care of by periodic washing, with saturated steam for water soluble deposits. Recently, a procedure of washing with a caustic solution has been developed for water-insoluble silica deposits. The latter, it has been definitely demonstrated, can be carried out in cases where the remedies available heretofore could be carried out only by opening the turbine and cinder blasting turbine nozzles and blading. The ability to remove such insoluble deposits almost completely by injection of caustic solution has removed one of the major contributing causes to opening turbines at frequent intervals. The process, therefore, deserves particularly close watching and further development.*

Nevertheless, and even with the most intelligent observation of turbine operation and performance, and the carrying out of such remedial measures as can be effected without opening, a period is reached for any steam turbine if operated under conditions of high use factor (say of 8,000 hours a year or more), where it becomes not only desirable but necessary to take down the turbine if no jeopardy to equipment is to result, and particularly if the turbine is to be run with confidence and assurance for another period approaching or equaling 25,000-35,000 hours.

Maintaining the Condenser

As regards the condenser, intelligent operation, particularly such operation carried out with the help of tools such as proper screening arrangements, arrangements for reversal of flow where trash has to be contended with, automatic and continuous chlorination arrangements where algae formation are encountered—such operation is particularly helpful in the case of the condenser and brings about optimum availability. But even here some conditions will develop sooner or later that will necessitate a lengthy shutdown. Included in this category is tube erosion, that makes necessary complete or partial replacement of tubes, and wear or erosion of circulating pumps. Neither of these two conditions, however, will generally be so critical that they cannot be postponed for an appreciable period of time, even though with the loss of some efficiency, but still without appreciably jeopardizing the substantially full capacity of the unit, until such time

* See paper "Removal of Water-Insoluble Turbine Deposits by Caustic Washing," by W. L. Webb and R. G. Call, to be presented at a coming meeting of A.S.M.E.

as either the principal boiler or turbine, of which they are a part, has to be taken down, and thus permit the carrying out of this work without increasing the size of the block of lost capacity.

Coordination for Minimized Outage

The object of any program of coordination of major unit outage is to maintain the maximum margin feasible between demand on a system and load capability of the various plants serving the system. For an individual system this means careful study and evaluation of the shape of the annual load curve and the shape of the annual capability curve. The latter involves taking into account not only seasonal variations in hydro capability but seasonal variations in steam plant capability. However, in wartime, with rapidly growing loads, three other factors have to be taken into consideration. These are (1) the rate of growth of new load, because such growth can overbalance the seasonal trend factor, (2) the rate of bringing in of new capacity on the system and (3) the broad integrated regional area picture. This last is particularly important because, while it is desirable to coordinate the various power groups in a broad regional area in peacetime, or normal times, it is a "must" in wartime.

Giving consideration to these three factors will materially alter the program of scheduled generator unit outage that might otherwise be set up by independent operating groups in a particular area. No better way of showing this is available than by specific example; Fig. 1 shows a typical outage schedule set up on a major interconnected and integrated system in December—for that month and for the entire succeeding year. Several things will be noted:

First, that the program projected in Fig. 1 involves as many as twenty units in seven different plants. Yet it was found feasible to project a schedule of that sort a year in advance. The actual projection indicates a concentration of maintenance in substantially the first seven months of the year, the basic reason for that being in this particular case, first, the fact that the annual peak of the system was expected in November or December, and, second, that the hydro situation, which in this case comprised some 8 percent of the total available power supply capability, has a rapid diminution in the last 4½ to five months of the year.

Finally, the particular system having 80,000 kw. as its largest block of generation was used as a criterion for the largest block of power scheduled for outage at any time.

Flexible Sequence

How this program was actually carried out in practice is shown in Fig. 2. Here it will be noticed that while maintenance was carried out at the scheduled seven plants, the total number of units overhauled was actually 24; *i.e.*, 20 percent in excess of the schedule. Nevertheless, the basic pattern was adhered to as a comparison of Figs. 1 and 2 clearly indicates, although for short periods of time, running generally into a few days, except in one case, the maximum outage figure of 80,000 kw. was exceeded. Also, although no capacity was initially scheduled for outage beyond the first third of August, in the final setup it was found possible to remove unit 2 (it had reached a period where it had been operating without inspection for close to four years) at plant "C" in the latter part of September and the first half of October, and to take out a unit at plant "D" during Thanksgiving Week. The order, it will be noticed, in which units were scheduled for overhaul was not rigidly adhered to, and the need for such flexibility in carrying out long term plans and schedules is particularly important in these critical war times.

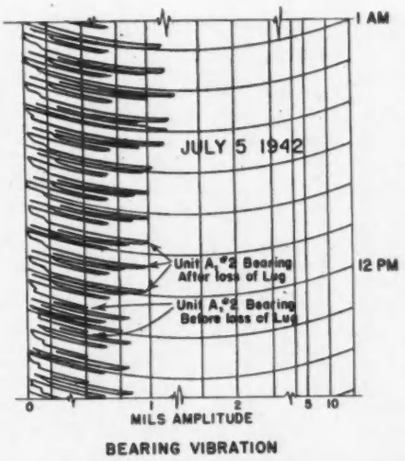


FIG. 5—Vibration recorder charts, continuously watched, serve as excellent alarms when the first phases of mechanical failure show up. The breaking of a tooth on the jaw coupling of a turbine resulted in a jump in the vibration of the nearest bearing from ½ to 1 3/16 mils

Coordinating 6,500,000 Kw.

An example of wide area coordination in scheduling of major overhauls is shown graphically in Figs. 3 and 4. Fig. 3 is a schedule of outage for major overhaul for a period of sixteen months, of four contiguous areas forming a major area with a demand by the end of 1943 estimated at close to 6,500,000 kw. Note that in this case the program developed bears almost no seasonal character. As a matter of fact, the basic reason for its particular shape cannot be appreciated until an examination is made of Fig. 4. This shows the capacity available in the individual areas for unpredicted outage, for reserves and for further load growth, after taking care of scheduled overhauls indicated in Fig. 3, and after meeting estimated peak demands.

It will be noticed that the program developed in Fig. 3 had for its object, in so far as possible, leaving in each sub-area, and in the major area as a whole, under all conditions, a margin of capacity approaching the minimum necessary to operate the systems. That was actually accomplished with remarkable effectiveness under the schedule projected in Fig. 3, with the exception of area "A," which shows slight negative margins for two months out of the sixteen. Considering the tightness of the capacity situation expected in wartime, that, obviously, is not a matter for great concern. It is worthwhile and pertinent to point out that the degree of coordination indicated by Figs. 3 and 4 was not obtained casually, but required a great deal of work within each of the sub-areas and a considerable amount of close and effective coordination in the centralized group.

The solution of the problem of minimizing the outage time of each

particular scheduled major overhaul can be divided into two parts, the first involving preventive, or prophylactic measures, and the second involving organization. As regards the first, reference has already been made to the extending the time between scheduled overhauls by turbine washing, and particularly the utilizing of stage pressure differentials as a criterion of the need of such washing.

Too much emphasis cannot be made of the point that while internal washing of a turbine may be considered a routine operation, in effect it is a form of maintenance, and that not only can turbine efficiency be improved thereby and time between scheduled outages lengthened, but it is a definite further insurance against possible damage. For it is obvious that when the differential pressure in any stage group builds up to an appreciably greater value than exists in the case of a clean turbine and approaches the maximum allowable, the turbine is jeopardized if it is not washed or the pressure brought down in some other manner.

Reliance on Instruments

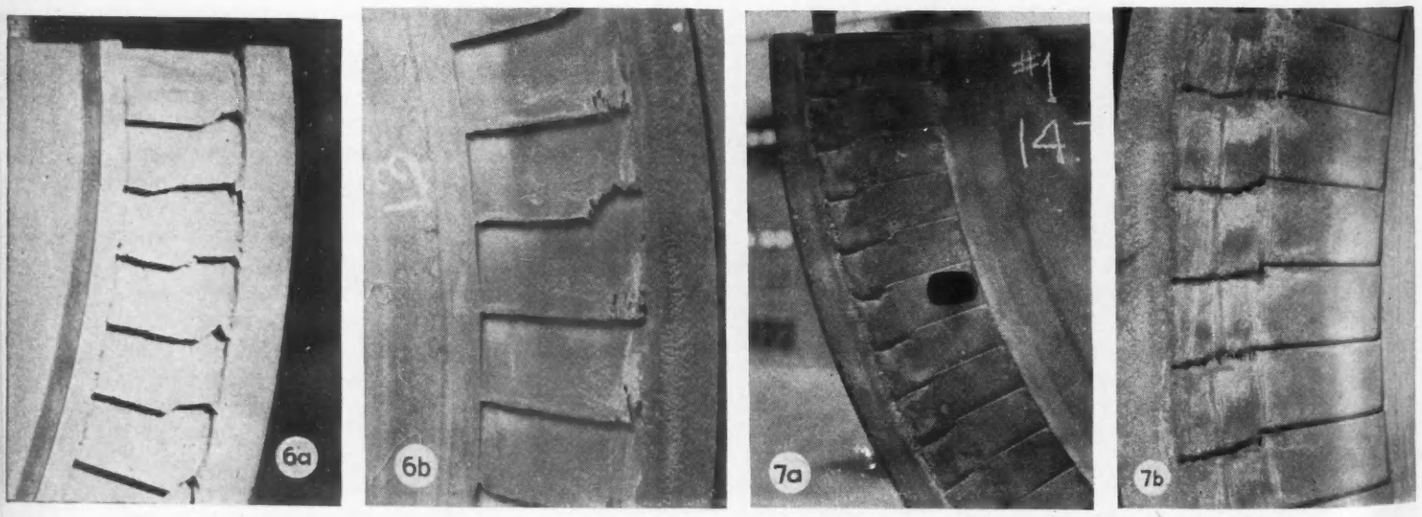
In the same category of prophylactic measures can be placed the utilization of well-known instruments developed in comparatively recent years, such as shaft eccentricity and vibration recorders. A typical example of protection against the development of serious damage by the use of such instrument indication is shown in Fig. 5. This is a sample of a chart from a vibration recorder connected to record the vibration of several turbine bearings. The No. 2 bearing of turbine "A" had, over an extended period, been operating with a vibration of approximately $\frac{1}{2}$ mil, when the vibration of the bearing suddenly started increasing to about $1\frac{3}{16}$ mils. The turbine, in this case, was shut down and the inspection revealed that a tooth of the jaw coupling had broken off completely, because of fatigue where a long existing crack was found nearly completely across the tooth section. It is apparent that the instrument indication prevented what might have resulted in much greater damage.

The effectiveness of proper organization in reducing the total time within which a particular major job of overhaul can be carried out is obvious. Nevertheless, it needs to be pointed out that this goes beyond mere setting up of proper personnel under proper supervision, organized to carry out the job in an expeditious manner. This is particularly true in these times when critical materials are so scarce, and where the manufacture of essential parts to the repair of turbines, pumps and similar equipment is carried out by organizations engaged for the most part in the manufacture of essential war material.

Photographic Records

Making certain of having available parts needed for replacement when a turbine is shut down is not easy. But it can be accomplished if the work has been planned properly. For example, it is possible at time of scheduled internal inspection of a machine to photograph those parts which are approaching the end of their useful life period, as indicated by observation and from study of the elapsed service hours, and to record this condition in detail in a report. If this is done systematically and carefully during each successive inspection the records obtained thereby can serve as an almost infallible criterion for advance ordering of necessary spare parts.

Careful comparison, for example, of the progress and the wear from one inspection to the next will make it possible to predict with rather good accuracy when a part needs to be replaced. This, of course, is not an exact science, because some parts, in spite of their appearance, will last much longer than their predicted life period even though such a prediction is made after the part has lost the major part of its life. However, the



FIGS. 6 and 7—Carefully made and continuously kept photographic records of critical parts of turbines can serve as a sound criterion for ordering of replacement parts well in advance of actual overhaul outage. Note and compare Figs. 6a and 7a with 6b and 7b, there being a two-year interval between the "a" and "b" photographs of two turbine diaphragm nozzles. Study of the "a" photographs and comparison with previous records led to conclusion of need for, and subsequent ordering of new diaphragms for next inspection. This the "b" photographs confirmed

risk of damage to other parts and the consequent forced outage of the machine will in many cases make it not only a good investment to install the replacement part in advance of the failure point, but such operation is definitely very sound wartime practice.

As illustrative of this, note Figs. 6a and 6b and 7a and 7b. These are typical photographs of turbine diaphragm nozzles indicating the progress in wear from one inspection to the next. Following the 1940 inspection of the nozzles shown in Figs. 6a and 7a, it was decided from an examination and study of the pictures and descriptions taken on previous inspections that it was probable that new nozzles would be required on the next inspection. When the turbine was opened up, in 1942, the condition of the nozzles confirmed the previous prognosis, as both Figs. 6b and 7b will show. As a result the diaphragm nozzles were replaced during the 1942 overhaul. But because of the conclusions reached after the 1940 overhaul, these nozzles were ready and available when the 1942 inspection was made. Of course, it is sometimes difficult for photographs alone to give a true indication of the condition of a part, but when these are accompanied by a careful description of its condition by an experienced technician the progress in the wear is definitely measurable.

Such work and organization not only has the advantage of making it possible to order parts early enough to give the manufacturer ample time for fabrication—a situation which is particularly critical at the present time—but it has other advantages besides. For example, it permits time to work out improvements in the detail design in order to improve the performance and decrease the wear of the new part. Again, in many cases it will offer possibilities of change in the design so as to bring about better interchangeability with sister machines of a later vintage on the same, or neighboring, systems. In this way the new part, although intended as a renewal for a definite turbine, can also be utilized as a protection against unexpected and premature failure in a similar machine, while the part is lying in the storeroom awaiting its ultimate destination. The same kind of procedure can be carried out to a considerable extent on other major power plant equipment.

Conclusion

The problem of coordination of major overhauls of the generating units on a large system, or in a large coordinated area, is, it is obvious, more involved than can be covered extensively or in detail in a short article. What is given here, however, ought to serve as sufficient indication that coordination and advanced planning of such a program can bring excellent results. However, a word of precaution here is also necessary. Advanced planning has definite advantages, but the problem is so important that it is necessary to keep working on it continuously, and particularly to watch equipment, because it is obvious that the equipment may not be at all aware of the schedule that has been set up for it. Furthermore, loads may come up faster, or may not come up as fast as contemplated. New capacity additions may behave equally erratically. Thus, changes in both of these factors will have a material influence on the reserve available on the system, and therefore on the overhaul program that the system can stand. Again, where hydro-electric capacity is a factor, its vagaries have to be taken into consideration.

With these many factors subject to variation, it should be clear, therefore, that it may become desirable and frequently necessary to change quickly any program planned in advance as the battlefront between capacity and load changes. Nevertheless, the planning of such a program in advance is an enormous help and is the only sound way of carrying out such a program in times when capacity is as critical as it is bound to be in wartime. Only on this basis can the power battle—the battle to keep generating capacity slightly ahead of the load—be won. In the case of a modern war, this is a very important battle, and the winning of it can serve as a major contribution to the main job of the moment—the winning of the war.

Air-Cooled Arch Stops Spalling Ills

The simple change from a solid- to an air-cooled burner arch in certain boiler furnaces at the Michigan City generating station of the Northern Indiana Public Service Company has largely eliminated troubles with temperature spalling of fire brick in the suspended arch surrounding the pulverized coal burners. Air cooling of the arch has increased its life from about two months to 1½ or two years, considerably reducing boiler outage time and cutting boiler maintenance costs.

Furnaces in which the troublesome arch existed had a heat release rate of about 32,000 B.t.u. per cu.ft. In these furnaces a suspended solid fire brick arch separated the burner air box and the furnace.

Furnace temperatures caused the brick in this arch to spall away and expose furnace castings to dangerously high temperatures every two or three months.

To correct the trouble the shape of the brick used in the arch was changed from a solid- to a modified "I"-shaped brick which provided a small space between bricks through which air could pass from the air box into the furnace. Quantity of air passed into the furnace in this way was not sufficient to disturb combustion, but it did have the effect of cooling the slag coming in contact with it, causing the slag to solidify and build up a protective surface on the brick that further prevented destruction.

The change in the shape of the brick was the only alteration in the arch necessary. Cost of the air-cooled arch was the same as for the solid arch. No additional installation cost was incurred since the arch had to be replaced anyway.

Forced Outages Discouraged by Hunting for Trouble

Maintenance executive enumerates measures deserving emphasis in operation and maintenance to promote long-duration reliability of steam generating facilities

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PRESSURE to keep equipment operating without distress has become so familiar that it needs no elaboration here. But that same urgency to "power the war" warrants a restatement of many equally familiar factors so that nothing important will be overlooked, in the typical plant, in the process of assuring maximum dependability of the steam-producing part of the electric generating station.

No one can put into two or three pages all the things that need to be watched diligently if the equipment is to work long hours without a hitch, but there are certain points which stand out above the rest and experience shows they are frequent sources of trouble. As we see them, the following factors of operation and maintenance are worthy of timely attention because, if neglected or postponed unduly, they result in predictable losses in efficiency, fairly predictable deterioration of parts and fairly predictable shortening of the intervals between unit shutdowns for major overhaul jobs.

As a result of experience gained in the design and operation of modern high-pressure, high-temperature steam-generating units over the last five or six years records are available of a number that have operated 98 to 99 percent of the total hours in a year at an average load of around 85 percent of maximum. Such reports come from widely scattered areas and are largely associated with the burning of various grades of coal under favorable load conditions and well-trained operating personnel.

While local considerations in many cases preclude the attainment of such enviable records, they represent a goal that can be approached by the observance of certain procedures. Of greatest importance at the present time of increased loads and reduced reserves is the avoidance of forced outages through vigilance that will detect and overcome impending trouble before it develops.

Slagging

Excessive slag accumulation on heat-absorbing surfaces not only interferes with heat transfer but also tends to produce high draft loss. It may be due to one or a combination of the following:

1. Large increase in load.
2. Long continuous peaks.
3. Change to a poorer grade of coal.

With bare metal walls and fairly constant load, there is a tendency for the slag to build up to a state of equilibrium, after which it will cease to increase in thickness and will run down in a fluid state. However, a large increase in load or a long continuous peak is likely to result in excessive slagging, and in such cases it is desirable, where possible, to arrange the loading schedule on the various steam-generating units so as to permit a drastic reduction in rating for an hour or two on those units which are carrying the base load. This will assist in clearing the walls of some of the slag. In certain sections, where natural gas is burned as an alternate fuel to pulverized coal, the walls may be completely cleaned during operation with gas, although this is likely to affect the superheat.

Difficulty in maintaining the multiple-nozzle type of soot blower for service in modern high-duty boilers has resulted in widespread use of the retractable or telescopic mass blower which will effectively handle porous slag. If the slag is plastic, however, hand lancing is usually necessary. Practice is divided between hand lancing with water, steam and air, but care should be exercised with water to keep the jet moving and avoid impingement on tube seats and headers. Air, or steam, is preferable for cleaning superheaters. It should be borne in mind that leaks caused by improper lancing may incur an unscheduled outage.

Thermocouple Aids

Where there is partial slagging of the superheater, or incomplete deslagging, laning of the gas stream may result and cause excessive temperature in some elements. For this reason it is advisable to install thermocouples on the superheater elements and outlet pipes and take hourly temperature readings. These should indicate impending trouble in time to avoid tube failure.

Research has gone far toward identifying the factors that make for slagging characteristics of a coal, advantage of which can be taken in normal times in the selection of coal, but under present conditions it may not

always be possible to utilize this knowledge. If it becomes necessary to burn coal of a lower ash-fusion temperature, the temperature of the furnace gases may be reduced by increasing the secondary air. This will mean operating with lower CO_2 and the load on the fans will be increased. Also, if a change is made to lower volatile coal, when burning pulverized coal, fine pulverization (through adjustment of the mills) becomes necessary in order to insure stable ignition and keep down carbon loss.

Boiler Water and Feedwater

Not only is it most important to determine the proper feedwater treatment for the given installation, but it is equally important that a constant check be maintained on the condition of both feedwater and boiler water. This is not the place to restrict supervision if short of man-power.

Strict and continuous watch should be maintained to detect the presence of oxygen in the feedwater. Intermittent observation at appreciably long periods may lead to false conclusions. If oxygen is detected, the cause should be determined immediately and the condition corrected. Condenser leakage is often a large contributing factor and a check should be made against inadequate vents on deaerating heaters as well as all other places of possible leakage of air into the system. If no oxygen scavenging agent is employed, the possibility of its use should be investigated.

Make certain that the principle of operation of the drum internals is thoroughly understood and that they are maintained in proper condition, as localized leakage at joints that are intended to be tight may cause trouble from carryover.

It is important that some system of steam quality checks be put into force. Aside from the effect of carryover on the turbine capacity and efficiency, carryover may damage the superheater. This is especially true in high-pressure, high-temperature units. It is therefore advisable to provide, where possible, means for taking samples in each of the inlet multiple steam connections to the superheater, in order to detect carryover arising from localized leakage in the drum internals. Admittedly, this is a big undertaking, but it is fully justified where suspicion of such leakage exists.

It is axiomatic that measures be taken to insure that the interior surfaces of all tubes be maintained clean and free from scale. In this connection it may be well to investigate acid cleaning methods of internal boiler surfaces as practiced successfully by some operating companies.*

Economizers

Watch the temperature rise of the water in relation to temperature drop of the gases; also, the water temperature and pressure drop as well as draft losses for indications of loss in heat recovery due to fouling of the heating surface.

Make certain that the soot blowers are in proper alignment; misalignment may result in cutting and ultimate failure of economizer tubes.

Air Preheaters

Low-grade coals tend to contribute to deposits in air preheaters and, because of the generally higher sulphur content, to corrosion when the temperature of the exit gas falls below the dew point, as may happen when a unit is operated at low output for extended periods. Furthermore, when burning natural gas as an alternate fuel, the greater amount of water vapor in the flue gas is likely to result in some condensation and consequent corrosion. When burning oil there is likely to be condensation of oil vapor when operating at low rates.

The surfaces of some types of air preheaters may be cleaned either by use of soot blowers or by washing with hot water. If soot blowers are employed, superheated steam is preferable to minimize condensation and the pressure should be kept below 200 lb. It is important to make certain that all lines are properly drained before operating the soot blowers. Frequency of blowing is governed by the character of the coal and the operating conditions, but once per shift is usually sufficient.

Air preheaters of the regenerative type are often equipped with a water-washing system, and it is important both that sufficient hot water be used and that sufficient time be allowed for complete drainage.

Several means are available for controlling the temperature at the cold end of such an air preheater. These include cold air bypass, hot air recirculation and gas bypass. Of these the cold air bypass offers certain advantages. With this, part of the air from the forced-draft fan is bypassed around the air preheater and mixed with the hot air for combustion. While this reduces the thermal recovery in the air preheater, it also results in a higher mean temperature at the cold end and thus lessens the chance of corrosion.

Operating records of air temperature rise and gas temperature drop through the air preheater will serve to indicate excessive setting leakage. Also, records of draft loss on the air and gas sides will assist in checking setting leakage and tend to indicate the condition of the heating surfaces. Any boiler may be checked for setting leakage by measuring the CO_2 drop between the furnace and the uptake.

Pulverizers

If it becomes necessary to change from the normal source of coal, an effort should be made to purchase coal with grindability and ash content comparable to that formerly burned. A lower grindability and high moisture content mean loss in mill capacity. In general, high-volatile coals have lower grindability than low-volatile coals. If the coal contains excessive moisture, it will tend to hang in the bunker, chutes and mill feeder and cause interruption; also reduce mill capacity. Coal that contains too large lumps may cause irregular feeding. With high-moisture coals preheated air of at least 500 F. is desirable. Low-volatile coal requires adjustment of the mill for finer pulverization.

Maintenance costs with coal of constant quality depend on hours operated rather than tonnage. That is, with the bowl type mill, 1,000 hours operation at full load apparently causes no greater wear than 1,000 hours at half-load. It is therefore desirable to investigate the possibility of holding full load on some of the

* See "Two Methods Used to Acid-Clean Boilers," "Electrical World," July 25, 1942, pages 95, 96.

mills by shutting down others during off-peak periods, instead of operating all the mills on partial load during such periods.

It is well to establish the optimum operating hours and tonnage to base the frequency of inspection and thus avoid time lost through excessive wear. When it becomes necessary to purchase different coal of a lower quality, new schedules of repair outage should be set up.

Stokers

With stokers of the multiple-retort types, low maintenance involves a relatively good grade of coal, moderate air preheat and close control of the air admitted through the fuel bed. With low-grade coals the formation of troublesome clinkers often limits fuel burning rate. These will affect the distribution of air, result in excessive ash-pit losses and involve higher maintenance. It is important that the coal sizing be uniform across the hopper. When coal size analysis includes a wide range, handling machinery should be carefully checked to prevent segregation of sizes. If it becomes necessary to use a high-moisture coal agitators in the hoppers should be provided. The side walls should be kept free from clinker formations, by removal with a slice bar; otherwise, travel of the fuel at the sides will be retarded. Furthermore, where clinker grinders are employed, it is important not to permit the refuse to catch fire under the grinder as the heat will tend to distort the rolls. The pit should be kept ground down to the level which will protect the overfeed section and yet not interfere with mechanical distribution of coal by the stoker. Instruments should be provided to record the underfire and overfire draft; also the CO_2.

With stokers of the traveling grate type, the following suggestions are offered as to inspection and maintenance that should avoid forced outages. Some of these, obviously, are also applicable to the multiple-retort type:

1. Inspect all accessible parts of stoker daily and examine stoker completely when shut down—at least twice yearly.

2. Replace broken grate elements promptly to prevent excessive sifting loss. Allow clearance between grate elements when assembling to avoid damage due to their natural growth under heat and protect the wind boxes with 1 in. grout at bottom so that sifting fires will not damage the sheet iron.

3. Operation with distorted grate bars or rods may cause extensive damage.

4. Badly worn grate bar ends and driving chains, burned ledge plates, or the continuation of these conditions, can cause excessive air leakage along the grate line. The resulting "blow-torch" action is very destructive to parts in this area.

5. Check wear on chains and sprockets frequently, reversing them when badly worn to prolong their useful life. Proper chain tension should be maintained by adjusting "take-up" regularly. See that chains engage the sprockets correctly and advance evenly to avoid rapid wear. Lubricate with correct oil and grease.

6. Check gate tile and supports regularly. Replace promptly when burned or warped to assure even fuel bed thickness.

7. Inspect drive mechanism occasionally for wear on gears, condition of bearings, alignment and lubrication.

8. Check alignment of shear coupling occasionally to be sure that it functions properly. Never use makeshift shear pins. If standard shear pins fail, determine the cause of overload before starting up.

9. Inspect return rails when possible. Replace badly worn wearing strips promptly.

In conclusion, it may be well to stress the importance of maintaining accurate and complete operating records and study these closely to make sure that operating standards are being maintained and to anticipate trouble in time to prevent failures or unscheduled outages.

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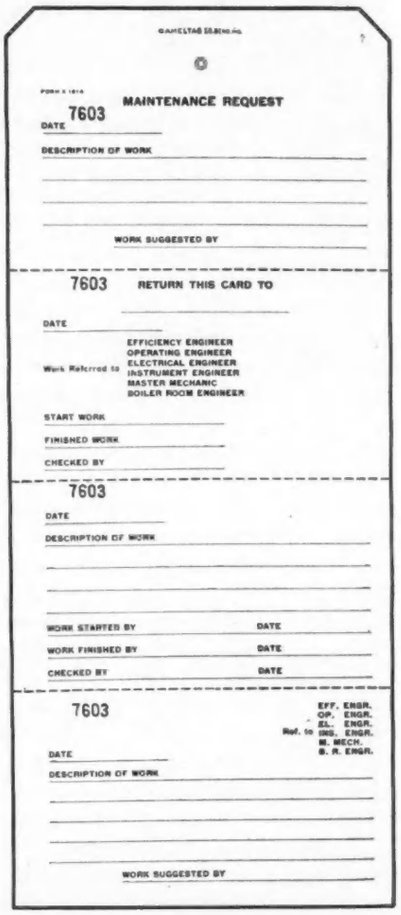
Tag System Guides Plant Maintenance

Different sections of the four-in-one maintenance control tag, shown herewith, and used at the Spy Run plant of the Indiana Service Corporation, serve variously as: (1) Identification for defective equipment in the plant; (2) maintenance request; (3) maintenance work order, and (4) work progress control card. Each section of the tag bears the same serial number for cross-reference purposes.

Operating foremen in the plant are provided with a number of these tags which are used in event of unforeseen failure of plant equipment. When a case of trouble develops the date, description of work and operator's name is entered on the top section of the card. It is then detached and fastened to the machine in trouble. Remaining three sections of the card are filled out and directed to the plant superintendent, who retains the second section for follow-up purposes, indicating thereon to whom the work was referred. Remaining two sections are directed to the maintenance supervisor, who retains one of the two remaining sections and passes the final



FOUR-IN-ONE maintenance control tag guides work scheduling

section to the foreman of the maintenance crew.

When the repair work is completed the machine tag is removed and with the crew work order returned to the maintenance supervisor, who indicates that date when the work was finished on his card and returns the three sections to the plant superintendent, indicating that the work is completed satisfactorily.

This tag section has been used at Fort Wayne for some time and has proved effective in keeping responsible work supervisors accurately informed on the status of outstanding maintenance work.

Indexes That Point to Turbine Overhaul

Declining efficiency of operation and departures in stage pressures are warnings that deposits exist or there is other damage in steam passages

E. E. HARRIS and G. B. WARREN, Turbine Engineering Department, General Electric Co., Schenectady

GENERAL PRACTICE suggested by turbine manufacturers and usually followed by the majority of turbine operators under normal conditions is to inspect a new turbine unit in the period between six months to a year after it is initially placed in service, then to carry out subsequent inspections after approximately 10,000 hours of operation. This would, of course, require inspection under normal operating conditions every two to five years, depending upon the load factor of the turbine under consideration.

On older turbines — that is, turbines more than ten years old—it has been the general experience that inspections of this frequency are good insurance against unscheduled outages because potential difficulties can generally be anticipated and repair material accumulated in advance of inspections.

Inspection periods or the number of hours operation between one inspection and the next inspection depend upon the condition of the unit at an inspection.

On more recent turbines, on which bucket difficulties have been reduced to a very great extent, it has been found that the period from the initial installation to the first inspection is the critical one, because then difficulties due to foreign material or deposits, or those originating from design modification, are likely to show up, and after that period it may be safe to extend the time between inspections, as suggested above, and some operators are even carrying the operating time between inspections to as much as 20,000 hours.

Under conditions such as exist at present, considerable pressure is naturally being put upon operators to extend as much as possible, consistent with good operating procedure, the time between routine inspections in order to avoid the outage that such inspections involve with resultant loss of machine output. Such practice is, of course, desirable if it can be carried out without jeopardizing either the safety of operation, the potential maximum capacity of the unit, or reducing unduly the efficiency with which the machine should operate.

A recent article has dealt with precautions that should be taken in order to insure the safety of turbine opera-

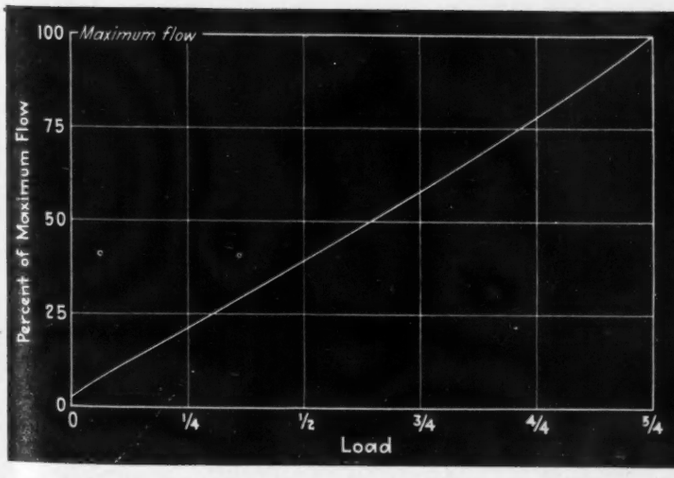


FIG. 1—A Willans line under normal design bleeding conditions

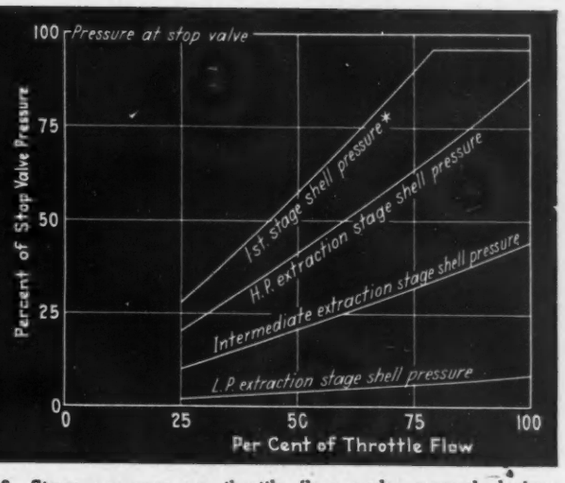


FIG. 2—Stage pressure vs. throttle flow under normal design bleeding conditions

*The first stage pressure curve is typical of a specific design and may differ in shape for other designs.

tion.* The present article deals with means whereby the turbine operators can be aided in attempting to determine in advance of a major turbine inspection or overhaul whether or not there is need for such inspection or overhaul.

Efficiency an Indication

Many power plant operators make a periodic check, sometimes daily, sometimes weekly, of the operating efficiency of each turbine unit. If reliable flow meters and load indicating meters are available, this can be done without much difficulty or expense, and is most easily analyzed if the turbine is brought to a standard load and if care is taken to restore steam pressure and temperature to standard values each time such a check is made. Usually the corrections for changing vacuum are quite readily made and available from the data supplied by the manufacturer in the turbine contract, or if not, can be obtained from Fig. 5. If a turbine has not fallen off in efficiency its internal condition must be rather good. A gradual falling off in efficiency or a sudden change in efficiency would be cause for investigation.

Operators also have at hand another useful tool for guiding them in the operation of a steam turbine; that is, the stage pressures for various sections of the turbine will show by their changes from the original conditions whether or not a unit is changing in its internal conditions due to: (1) an accumulation of nozzle and bucket deposits,† (2) by damage such as that caused by particles going through the steam passageways, or (3) damage by broken internal parts. Stage pressures may therefore be used to determine when a unit should be cleaned, either by washing or by opening for inspection and general overhaul, and such stage pressures can also be used to determine the extent of the cleaning achieved by washing. It is also possible to determine from the stage pressures whether or not a unit will be able to carry its maximum capacity without the necessity of loading the unit to obtain the actual maximum capacity.

A turbine designer designs into a turbine a certain pressure or energy distribution between the turbine inlet and the exhaust of the unit whether it be a single-cylinder unit or a compound unit. Such a pressure or energy distribution depends upon the amount of wheel speed available and is so proportioned as to reduce to a minimum the losses that are caused by the governing stage or stages, and determines the load division on a cross-compound or a tandem-compound turbine.

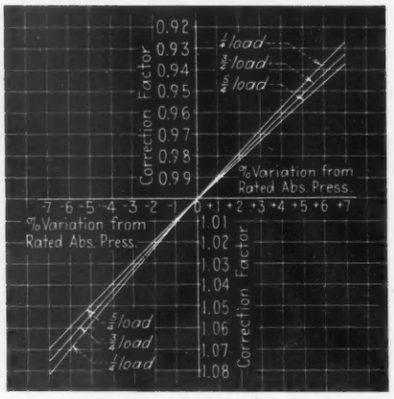


FIG. 3—Load correction multiplier for initial pressure with fixed control valve opening

$$\frac{\text{Observed Pressure} - \text{Standard Pressure}}{\text{Standard Pressure}} \times 100 = \text{Percent Variation from Standard Pressure}$$

This specific energy or pressure distribution results in certain design areas in each of the various sections or stages. The factory builds the turbines with as near an approach to the design areas as is possible considering certain factory tolerance limits for economical manufacture. The turbine is then shipped out, installed and put into commercial service.

At the time the turbine is designed the designer sets up a flow-pressure relation or a flow-energy relation, and since the output at the generator terminals is a function of the flow, available energy and efficiency of the various parts, a very definite flow-load relationship for the turbine has been established. This flow-load relationship is normally called a Willans line (Fig. 1) when flow is plotted vs. kilowatt output.

A stage, a group of stages or a section of a turbine will have a given pressure drop or a definite pressure ratio for the group at some flow with certain initial and exhaust conditions. If the areas are kept constant, then a very convenient relation exists in that flow is proportional to the absolute pressure ahead of the group except for a small change in pressure due to a change in temperature that may occur.

If the flow is changed and the pressure ratio is kept constant, then the pressure flow relation still exists for the group, so that when the pressure is plotted against flow for the group, a line will be established (Fig. 2) for the pressure ahead of each group of stages.

These lines are similar to a Willans line in shape and general direction of the curve, the chief difference being in the magnitude of the intercept on the vertical axis. Further, since the pressure for a group is a function of the flow and the flow is a function of the load, a stage pressure vs. load curve may be plotted (see Fig. 6). In actual operation of a unit the pressure-vs.-flow and the pressure-vs.-load curves become a very useful set of curves for the operator in making periodic checks on the unit. Such curves are nearly straight lines in that the pressure is nearly proportional to the flow or load.

Consequence of Extraction

In the actual operation of a turbine the pressure ratio is practically constant for a group of stages whose areas are kept constant throughout the load range, which is true of all stages but the governing stages. As turbines are designed at the present time, nearly all turbines are arranged for extraction for feedwater heating. Changes in the feedwater heating cycle for various flows may be encountered so that some small change in pressure ratio may be obtained. In the latter stages of the turbine the relatively constant back pressure will have an effect on the pressure ratio in the low-pressure section of a unit, although, generally speaking, a turbine maintains practically constant pressure ratio throughout, especially in the part of the turbine where it is desirable to know the pressure dis-

*"Maintenance Can Prevent Steam Turbine Accidents," by T. W. Howard, General Electric Company, *Power Plant Engineering* for October, 1942.

†"Effect of Nozzle and Bucket Deposits on Turbine Capacity and Efficiency," by B. O. Buckland, *General Electric Review*, February, 1942. "Effect of Nozzle and Bucket Deposits on Turbine Shell Pressures, Capacity and Efficiency," by B. O. Buckland, *Power Plant Engineering*, September, 1942.

tribution in a unit for checking its performance.

For the time being consideration is to be given to condensing units. Usually, as stated above, the exhaust pressure has practically no effect on the stage pressures because the lowest stage pressure measured is relatively far removed from the exhaust pressure for a condensing machine. In a non-condensing or topping unit all the stage pressures are affected by the exhaust pressure, and it would be desirable to obtain the corrections from the turbine manufacturer for such non-condensing units.

Previously in this article reference has been made to constant areas in the turbine and that pressure is proportional to flow. As the control valves function, the control stage or stages over the load range represent varying areas. If, however, constant control valve opening is assumed, then the areas are fixed for that control valve opening throughout the turbine, and the pressure flow relation for the complete unit is again usable.

Access for Readings

As turbines are normally designed and built, numerous places are available for measuring pressures and on older machines may be installed at inspection periods. Pressure taps may be provided in one or each of the steam admission points. In the high-pressure end of a unit, such as after a governing stage, a distribution space is usually allowed so that the pressures may be obtained immediately ahead of the fixed area stages. The pressures may be obtained ahead of and after inner shells, for there is a pressure chamber between the inner and outer shells. Stage pressures may be obtained in turbines that are arranged for extraction for feedwater heating at the extraction points. For compound units the exhaust pressure of one section and the inlet pressure of another section furnish excellent points for the measurement of pressures.

The manufacturer may supply stage pressure curves where pressure measurements may be obtained. These stage pressure curves are drawn for certain fixed steam conditions, such as initial pressure, initial temperature, exhaust pressure, feedwater heating cycle, etc. Unfortunately, it is very difficult for the turbine operator always to have the contract steam conditions, and since not having contract conditions, he may be at a loss as to how to correct for various conditions. However, the corrections are fairly simple and any readings taken should be corrected to standard conditions.

If the station is equipped with reliable steam flow meters the most convenient method of checking stage

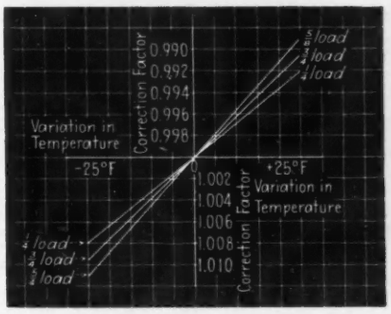


FIG. 4—Load correction (multiplier) for initial temperature with fixed control valve opening

Observed Temperature — Standard Temperature = Variation Temperature

pressures will be on a flow basis. The stage pressure curves supplied by the turbine manufacturer may be plotted against flow (Fig. 2) and probably would be supplied on a basis of pressures vs. throttle flow, with the pressures established on an extraction basis for normal feedwater heating.

The usual assumption to be made is that the readings taken will not be at contract conditions or conditions for which the stage pressure curves are drawn. In practically all cases it will be necessary to correct the readings, both flow and measured pressures, to standard conditions. For relatively small changes in temperature a very easily applied relation may be used for correcting the throttle flow to contract or normal initial conditions. At a constant control valve opening, and since constant areas throughout the unit exist, the throttle flow varies directly as the pressure and inversely as the square root of the absolute temperature, or flow varies as $P \times \frac{1}{\sqrt{T}}$ or $P \times \frac{1}{\sqrt{460 + t}}$, where P is the initial absolute pressure and T is the initial absolute temperature corresponding to temperature t. This flow relation then gives a very handy means for obtaining the flow at standard conditions for a constant control valve opening. In this relation it is to be noted that the temperature effect on the flow has been taken into consideration.

For large temperature corrections and for the turbine users who wish to spend a little more time, and also to acquire greater accuracies in their calculation, the more accurate flow relationship is that flow varies as the square root of pressure divided by specific volume or flow varies as $\sqrt{\frac{P}{v}}$, where P is the absolute pressure in pounds per square inch and v is the specific volume corresponding to the initial pressure and temperature. Either of these will then give the flow corrections to standard conditions.

Stage Pressure Correction

Stage pressures as read will also require a correction. In the superheated region of a turbine changing initial temperature or superheat will change the flow and not the pressure distribution. In the saturated or moisture region the pressure will be changed very slightly due to a change in initial steam conditions, since the flow coefficient of the stages in the moisture region is affected by the supersaturation and saturated condition of steam flow. For all practical purposes, however, it is merely necessary that the stage pressures as read should be corrected in direct proportion to the change in absolute initial pressure for fixed valve position as stipulated above. With the flow and stage pressures corrected to standard conditions, the corrected stage pressure may be plotted against corrected flow and compared with the manufacturer's prediction of what the stage pressure should be if the pressure curves supplied by the manufacturer are on a throttle flow basis. That is, this should be done on a curve furnished by the manufacturer for the specific machine and similar to Fig. 2. On an older machine such a curve can be made directly from the measurements if the machine is known to be in good condition.

For stations that are not so well equipped with flow meters the load

meters may be more accurate. In comparing the stage pressures against load, the corrections are more complicated, but still may not involve a too complicated set of calculations yet give fairly consistent results.

Initial Pressure Correction on Load

Most turbines are designed with a certain reasonable percent kw. exhaust loss under bleeding conditions at rated load and normal steam conditions, and since the exhaust loss curves for various exhaust sizes have about the same general slope and shape, the initial pressure corrections resolve themselves into a simple set of correction curves (Fig. 3) for fixed valve positions. This figure shows that for a certain percent pressure change from the base pressure, the percent load correction may be obtained for a variation in initial pressure. The load change obtained is the result of a changed flow throughout the various sections, change in efficiency due to a small change in superheat, change in available energy, change in exhaust loss and change in electrical and mechanical efficiency.

Changing the initial temperature involves changing all factors mentioned in initial pressure correction except the change in efficiency and change in available energy will be greater and the change in exhaust loss will be less. The net change will be as indicated in Fig. 4, here again for fixed valve opening.

With fixed valve position a change in the exhaust pressure has no effect on the throttle flow, but does change the quantity of extraction from the lowest pressure heater with a small change on the next heater above, changes the available energy for the condenser flow and may change the exhaust loss to a considerable extent. To take into account the effect of the exhaust pressure, Fig. 5 is submitted.

By using the initial pressure correction, initial temperature correction and the exhaust pressure correction the measured load at any valve opening may be corrected to contract steam conditions or some other standard set of steam conditions. The stage pressures should be corrected to standard conditions by correcting in the same proportion as the absolute initial pressure is corrected. The corrected stage pressures and corrected load may be plotted and compared with the manufacturer's curves if the curves are supplied on a pressure vs. load basis as indicated in Fig. 6.

Establish Curves

As soon as possible after a new unit is put into commercial service the stage pressure curves should be established either against throttle flow or kw. load and should be used as the basic curves for future comparison rather than the manufacturer's curves. The manufacturer's curves are intended as guide curves. These measured curves may be different from the design curves, but they, in most cases, will show about a constant percent difference from the design curves. The stage pressure curves as they are usually submitted by the manufacturer represent the pressure inside the turbine casing between the moving and stationary elements. The actual measured pressure may be different than the curves submitted due to: (1) Pressure drop from inside the turbine casing to the point of measurement of the pressure; (2) a velocity effect across the extraction opening due to the velocity of the steam going on through to the next following stage; (3) change in extraction cycle from the extraction cycle for which the curves were drawn; (4) actual flow coefficients not the same as used in the design, and (5) factory tolerances in manufacture.

If, as time goes on, the stage pressure curves show a gradual departure from the stage pressure curves obtained on a new unit with the percentage differences increasing with time, the indications are that the unit is becoming plugged with deposits. If a stage pressure curve shows a sudden departure from the original and then appears to stay at a percentage difference which is constant from the original stage pressure curve, the indications are that some internal damage has been done or that perhaps the extraction cycle has been changed, a gauge has been changed or has become inaccurate, thus giving a change from normal pressure curves. All external conditions should be checked

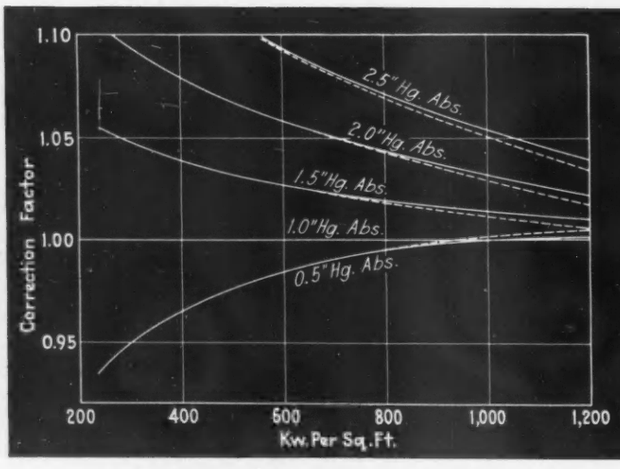


FIG. 5—Exhaust pressure correction (multiplier) with fixed control valve opening. Solid line curves for 1,800 r.p.m. Dotted line curves for 3,600 r.p.m.

$$\text{Kw./sq.ft.} = \frac{\text{Kw. Load} \times 144}{\pi \times \text{Pitch dia., In.} \times \text{Bucket active length, In.}}$$

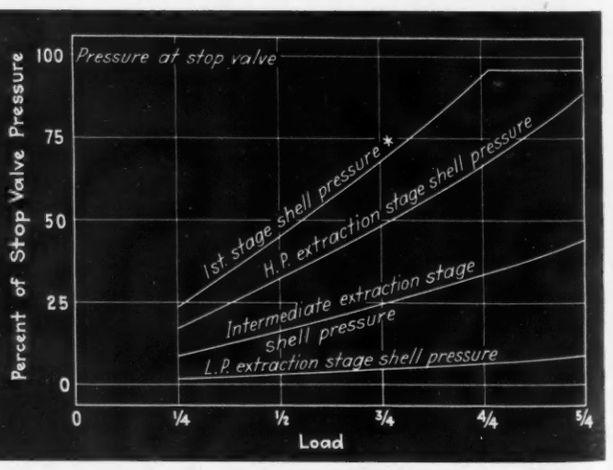


FIG. 6—Stage pressure vs. kw. load output under normal design bleeding conditions

*The first stage pressure curve is typical of a specific design and may differ in shape for other designs.

over to see that the sudden change in percent differences was not due to external change before inspecting for internal damage.

Another simple check, mentioned earlier in this article, on stage pressures and performance is used by various turbine users. This consists of periodically establishing as near as possible the same steam conditions, then loading the unit to a definite control valve opening and reading stage pressures and kw. output. The corrections in these cases are relatively small, and the whole procedure requires a relatively short period of time. In these cases the initial pressure and temperature may be established, and a correction will usually have to be made for exhaust pressure. Such exhaust pressure corrections may be obtained from the data in Fig. 5.

Percent-Departure Guide

Some turbine users plot percent difference between observed corrected stage pressure readings and manufacturers' design stage pressures or stage pressures obtained when unit is first put into service. Such a plot when made against time will show how the stage pressures are being maintained with respect to time and, further, will give a definite record of any abnormal change and the time of its occurrence such as may occur when internal damage is suffered in a unit.

The turbine itself under actual operating conditions when clean and in an undamaged condition gives the actual check on the turbine designer's calculations and assumptions that are made in the design of a turbine-generator unit. The designer is always interested in the actual performance of the unit under service conditions. When tests are run in the customer's station, stage pressure curves are practically always obtained and checked against the calculated or expected pressures.

The correction curves shown in Figs. 3, 4 and 5 represent corrections for the average turbine and apply generally for all turbines. If the turbine user is definitely interested in the specific correction curves that will apply for the unit under consideration, such correction curves may usually be obtained for the unit in question from the turbine manufacturer. In most present-day contracts correction factors are included in the contracts, and such correction factors may be used in obtaining the load correction factors for the unit under consideration.

It has been the intention to furnish a tool for checking steam turbine performance and internal conditions which may permit the maintenance of turbines in better operating condition with the minimum possible outage for inspection.

• • •

Prolonging Life of Condenser Tubing

C. A. GLEASON
Engineer in Charge of Technical Condenser Tube Service, Scovill Manufacturing Company, Waterbury, Conn.

Restrictions on the use of condenser tube materials containing copper and nickel make it more than ordinarily desirable to protect the life of tubes now in service in condensers. For this purpose it may be well to enumerate and classify the factors which tend to shorten the life —many of them familiar to well-informed station operators. To such extent as deterioration can be averted or deferred, there is the gain that comes from assurance that limited stocks can be conserved and also through escape from materials that would inevitably mean a retrograde movement of reversion to tube materials that long ago were found wanting in performance. Superior alloys now can only be obtained on proof of unusually deleterious condensing waters.

Failures of tube are due to chemical corrosion, mechanical erosion or mechanical fatigue; failures due to erosion or fatigue usually are accelerated by corrosion. Particularly where recirculation is practiced, it is often feasible to prevent calcareous deposits by small application of hexametaphosphate. Chlorination is effective against algae slimes. Fatigue can be ameliorated by giving the tubes a bias stress, often accomplished by elevating the intermediate sheet-supports slightly or inserting slats between the tube layers.

Erosion is considered to be primarily a matter of air impingement and many tube failures are averted if adequate attention is given to the elimination in design and operation of sources of released and entrained air. Some of the more important of these can be restated as follows, all more or less being associated with the elimination of pressure differentials which promote the formation of pockets, turbulence and eddies:

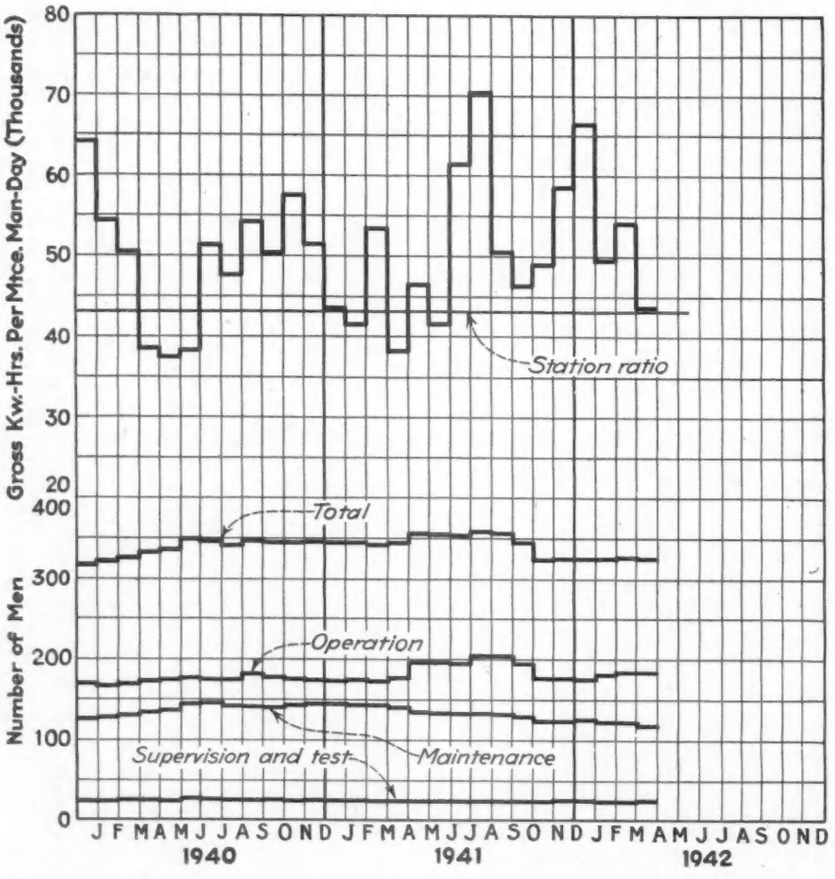
1. Watch screens to see that they do not pass foreign objects which lodge in or erode the tubes.
2. Have pump suction chambers ample in size to avert high-velocities and funneling at critical points.
3. Arrange pumps on header so the first in line will not lower the level and form an air pocket.
4. Leave air vents—do not seal in places where air can escape from a pocket.
5. Profile so that impellers will be under positive head. Propeller-type pumps are best submerged.
6. Place valve bonnets vertically downward if possible so, when opened, the air will not be entrained from the bonnet air pocket, or vent a vertically upward bonnet.
7. Throttling of condenser water at low loads should be done in the tail pipe beyond the condenser.
8. Check pump thrust rings for equality of wear and adjustment to avert turbulence on the narrowing side of the runner.
9. Be sure water seals are filled with water—*i.e.*, that there is a discharge at all times.
10. The more the pump blades wear the more likely they are to cause turbulence at their edges and tips.
11. Water boxes should have no inward projecting reinforcing ribs; these can usually be provided on the outside.
12. The injection nozzle should have a gradual enlargement of diameter to avoid sharp angles at the edge of the water box.
13. Inspection door pockets can be filled with oak blocks.
14. Division plates in two-pass condensers can advantageously be vented to let air pass to the discharge half of the box; in single-pass condensers an air by-pass pipe over the top has often been effective.
15. Eliminate projecting tube ferrules if possible and bell the tube ends to a proper hydraulic radius.
16. Leave time enough for a thorough, careful cleaning job which does not disturb any protective coating that may have been acquired or applied, especially at the ends.
17. Inlet end corrosion-erosion may be retarded by application of protective material such as "Debecote," or by use of short metallic inserts.

Plant Records Are Key to Maintenance Scheduling

Record of equipment service hours and output, maintenance job time and effective life of replacement parts guides advance scheduling of plant maintenance on Missouri system — Established relation between plant output and maintenance time checks the performance of the programmed work

A CAREFULLY articulated system of maintenance records, circumscribed by a precise scheme of checks and balances, is a key to the scheduling and execution of preventive maintenance by which steam station supervisors of the Union Electric Company of Missouri detect and forestall breakdown of plant auxiliary equipment.

Basic element of the system is a master maintenance schedule which details the maintenance operations programmed for the ensuing six-month period in the boiler room, turbine room, mill room, screen house and machine shop of each station on the system. It breaks scheduled maintenance down into jobs and indicates the days, number of men and man-days required for each task. A supplementary calendar shows the number of men assigned to each scheduled job by days for the entire six-month period. This schedule, supplemented by works-progress records, also to be discussed, gives supervising engineers a day-to-day picture of maintenance in progress, completed and contemplated.



GRAPH charting plant output in kw.-hr. per maintenance man-day used by supervising engineers to gage progress of scheduled maintenance. Heavy horizontal line marks ratio of output to maintenance man-days for particular station found to give best operation. Above standard ratio indicates lapses in maintenance; below standard indicates possible overemphasis on maintenance or drop off in load

Continuous comparison of equipment service hours elapsed between inspections and checks of actual and estimated man-days required for various operations are used to improve accuracy of succeeding maintenance schedules. In addition, as execution of each schedule proceeds, plant output per maintenance man-day is progressively compared with a "standard" ratio established by experience for that station to evaluate the progress of the schedule.

Scheduling Maintenance

Make-up of each six-month maintenance schedule depends almost directly on estimated monthly output of the station for the period under consideration. From experience it has been found that only a relatively small part of the maintenance work in a generating station is independent of station output. Bulk of the work to be scheduled depends upon

predicted month-to-month output. Because of this relationship it has been found possible at St. Louis to establish by experience a "standard" ratio of kw.-hr. output per maintenance man-day, for each generating station, that results in efficient operation. Ratios for stations of the Union Electric system vary from 26,000 to 130,000 kw. per man-day, depending on the station.

This ratio is used as a check when the schedule is made up to detect the omission of essential items. It also serves to gage the progress of maintenance work under the program. As work progresses, plant output is totaled monthly and compared with the corresponding actual man-hours taken from time records. The resulting ratio is plotted against them on a curve of the type shown. Fluctuations of this graph above and below the "station ratio" is used to check progress of the maintenance program. For example, if the ratio is higher than standard, the plant output is either higher than normal or some maintenance work is being deferred. On the contrary, if the ratio is below standard, output is off or previously deferred work is being cleared up.

It has been previously noted that in addition to detailing such maintenance job for six months, the maintenance schedule includes an estimate of the man-days required for each job scheduled. These estimates of job time for each task in the schedule are derived from past performance on that class of work. Under the St. Louis system, as each job is done the total time required to do the work is checked against the estimate. Deviations are noted and recorded for guidance of the plant superintendent in making the next time estimate for that operation. Over a period of years, an accurate average of job time is arrived at which can be used in future scheduling.

Thus by checking plant output against maintenance man-days progress of the schedule is kept in line, and by checking estimated man-days

MAINTENANCE SCHEDULE

JOB	OCTOBER															NOVEMBER					
DATE	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6
BOILER ROOM																						
No. 6 Boiler																						
No. 7 Boiler																						
No. 9 Boiler																						
No.10 Boiler																						
No.11 Boiler	15		15	30	30	30	30	15		15	30	30	30	30	15		15	30	30	30	30	15
No.13 Boiler																						
No.14 Boiler																						
No.18 Boiler																						
No.20 Boiler																						
Unit Mills	2		4	6	6	6	6	2		4	6	6	6	6	2		4	6	6	6	6	2
Heat Insulation			1	1	1	1	1			1	1	1	1	1			1	1	1	1	1	
Riley Mills	2			2	2	2	2	2			2	2	2	2	2			2	2	2	2	2
Soot Blowers				2	2	2	2				2	2	2	2				2	2	2	2	
No.13 Forced Draft Fan																						
No.15 Forced Draft Fan																						
Surge Tanks																						
Stacks No.1-2-3-4-5-6	2			2	2	2	2				2	2	2	2	2		2					
Sluice System	2				2	2	2	2				2	2	2	2				2	2	2	2
Sealing Air Leaks			1	1	1	1	1			1	1	1	1	1			1	1	1	1	1	
Boiler Arches				2								2							2			
Safety Valves				2																		
Blow-off Valves												2										
Def.Equip.Reports	8		2	4	2	2	2	2		2	4	14	14	14	2		7	12	4	10	14	2
MILL ROOM																						
No. 1 Mill																				4	6	3
No. 2 Mill																						
No. 3 Mill																						
No. 4 Mill																						
No. 5 Mill																						
No. 6 Mill																						
No. 7 Mill																						
No. 8 Mill																						
No. 9 Mill																						
No.10 Mill																						
No.11 Mill																						
No.12 Mill																						
No.13 Mill	3		3	6	6	6	6	3		3	6	6	6	6	3		3	6	6	2		
Transport Piping																	2	2	2	2	2	
Mill Hoppers & Piping																		2	2	2	2	2
Shooting Tanks																					2	
Mill Flow Points																		2	2	2		
Bin Cyclones																						
Mill Cyclones																						
Def.Equip.Reports	2		1	2	2	2	2	1		1	2	2	2	7	1		1	2	2	2	2	1
TURBINE ROOM																						
No. 5 Main Unit																						
No. 4 Main Unit																						
No. 1 Air Compressor																		2	2	2	2	2
Air Compressors																	1	1				
No. 1 House Turbine																						
Drip Drain Controls																						
Condenser Cleaning	2														2							
Boiler Feed Pumps																						
No. 2 Sludge Pump																						
Turbine Room Crane																						
No. 2 Raw Water Pump																						
No. 3 Raw Water Pump																						
No. 4 Raw Water Pump																						
No. 4 H.D.V. Pump																						
No. 5 H.D.V. Pump																						
No. 6 H.D.V. Pump																						
Def. Equip. Reports	4		2	2	2	4	4	2		2	4	4	7	6	2		2	4	4	4	4	3
SCREEN ROOM																						
No. 3 Screen																						
No.11 Screen													4	4	2		2	4	4	4	4	2
No.12 Screen																						
Printing																						
Water Treating Plant																				4		
Grating																						
Screen Ladders															2		2					2
Def. Equip.Reports																		3				
RAW COAL HANDLING																						
Motor Cleaning													2	2								
No.19 & 20 Bucket Elevators																						
Locomotive Crane 1188													3	3			3	3	3	3	3	
Locomotive Crane															2							
Boilers																						
Belt Conveyors																						
Chutes																				2		
Car Dumper			18	36	36	36	36	18		18	36	18	2	2	2		2	2	2	2	2	2
Yard Track																		5	5	5	5	
Def. Equip. Reports	2		2	2	2	2	2	2		2	2	2	6	6	6		2	2	6	2	2	6
MACHINE SHOP																						
Milling Machine																						
Shaper																						
Lathe																						
BUILDING & GROUNDS																						
Painting	2												4	2	2			4	4	4	4	2
Grating	2											2							2			
Def. Equip. Reports	1		1	1	1	1	1			1	1	1	1	1				1	1	1	1	1
TOTALS	49		50	99	99	99	99	49		50	99	99	99	99	49		50	99	99	99	99	49

MASTER maintenance calendar programs maintenance jobs by days for six months in advance. Opposite each job and under date is number of men assigned to designated project (only a portion shown)

FORM 601 — 2 SHEETS REQUIRED

REPAIR REPORT
CAHOKIA POWER PLANT

Refer to defective equipment report. No. 28622

Equipment repaired: No. 15 B Mill oil line

Location: Boiler room — Second Section — Grade 20 Date completed: 3/4/40

Remarks relative to repair: Repaired 3/8 in. oil line

Six Man-hours

Form 602 — 4 SHEETS REQUIRED

DEFECTIVE EQUIPMENT REPORT
CAHOKIA POWER PLANT

No. 28622

Follow-up

Location: Boiler Room — Second Section— Grade 20 Date: 3/3/40

Equipment requiring attention: No. 15 B Mill oil line

Condition observed: Thread leak at tee connection to south bearing on the south line to pump Stopped up.

Reported by: John Doe

Referred to Mr.: Richard Roe for repairs. Date: 3/4/40

Remarks or instructions as to repair: Repairs should be made as soon as possible — joint now taped up.

Date to start job: 3/4/40 Signed: John Doe

John Doe

CROSS-REFERRED "defective equipment" and "repair" reports provide data on amount of unscheduled maintenance work to be expected in different classes of equipment. Allowance for "defective equipment report" man-hours is made in each six months maintenance schedule to allow for unforeseen failures

on each job against actual job time required a file of job-time data is accumulated that constantly improves the accuracy of future schedules. These two checks supplement each other to insure that the maintenance schedule will run off smoothly.

What Job When

Frequency with which different classes of equipment are scheduled for maintenance in succeeding six-month programs is not left to chance, but is as carefully checked as job time.

Life expectancy of replacement parts that are most susceptible to wear or failure determines the frequency with which apparatus should be programmed for inspection and repair. As machines are periodically maintained a record is kept of parts replaced. This record shows the condition of the part when removed and the service life which it attained. These data are used in determining when this part should next be inspected or replaced.

Conditions that cause deterioration of equipment vary with the class of the machine. With the majority of steam station equipment wear is proportional to output and service hours. Some equipment, however, deteriorates almost directly with age. Still other, usually minor, miscellaneous plant accessories are not easily susceptible to life evaluation either by comparison of service hours, output, or age. Provision is made, however, for all these classes of equipment in the scheduled maintenance program of this company.

Where life expectancy of replacement parts is proportional to output and service hours, as in the case of boilers, pumps, coal pulverizers, etc., data on service hours life of the weaker replacement parts are compared with the service hours elapsed since the last scheduled maintenance inspection. These data are obtained directly from plant operating logs. These logs do not always give data in terms of hours, but often in terms of units of machine output. In the case of coal pulverizing mills, for example, the record is in the form of tons of coal processed.

As service hours or units of output approach the number found by life records to be the point where wear becomes evident and trouble imminent, the equipment is scheduled for inspection. Forecasts of plant output make it possible to estimate almost to the day when safe operating life will be reached. Past data on man-days required for inspection and repair of that particular machine complete the information necessary in spotting the job in the six-month maintenance calendar.

Elapsed Time

Where deterioration of equipment depends on elapsed time, rather than service hours or output, such as is the case with piping, valves, wearing rings, packing, shafting, etc., other less precise methods are required to measure replacement life. At some St. Louis plants, such as Cahokia station, a card index file is used. This file covers such equipment as: (1) Raw coal and ash-handling equipment; (2) pulverized coal handling; (3) boilers; (4) feed pumps and primary air fans; (5) turbines and auxiliaries; (6) screens and raw water pumps, and (7) miscellaneous equipment.

On the cards in this file is given the date of last overhaul of each item of equipment under each classification, condition observed and parts replaced. The time intervening between repetitive repairs and parts replaced is used as a guide to the scheduling

of preventive maintenance on these items of equipment. The file cards are gone over at periodic intervals to see that no item is missed.

Defective Equipment Reports

Most schedules, made up in advance, are subject to upsets caused by unforeseen events. The "defective equipment report" system used in Union Electric Company plants is the flexible element which not only makes allowance in the maintenance schedule for unscheduled and mandatory maintenance but it is the control system that keeps such unscheduled maintenance to a minimum.

Defective equipment reports operate to identify each piece of plant equipment that requires unscheduled repair during a given six-month period and record the time required for its repair. Thus by classifying defective equipment reports by equipment types it is possible to enter on the maintenance card index file mentioned the date when each minor piece of equipment is replaced. Also by accumulating data on the man-hours of unscheduled maintenance over a period of time it is possible to make an allowance in future master maintenance schedules for "breakdown" maintenance and thus prevent upsets in schedule.

A defective equipment report, shown, is made out in quadruplicate for each case of equipment failure, identifying the equipment requiring attention, its location and the condition observed. These serially numbered reports are sent, one copy each, to the chief engineer of power plants, the plant superintendent, the maintenance supervisor and the master mechanic. The latter initials his copy and sends it to the foreman in charge of repair. When repair is completed a repair report, also shown, is made out indicating what was done and the man-hours required for the job. Copies of the defective equipment report and repair report cross-referred, are passed to the maintenance supervisor. He classifies the reports by equipment type and totals the defective equipment report time twice monthly and enters it on a control sheet for reference in making up the next six-month maintenance schedule.

When the maintenance schedule is made up past six-month totals of man-hours spent in repairing defective equipment of various classes are studied. On the basis of them an allowance is made for each class of equipment to take care of unforeseen events.

If review of defective equipment reports during the year reveals a sudden increase in the actual number of man-hours expected for the repair of any class of defective equipment, an investigation is started to determine if some major work was accidentally omitted from the schedule or if some job item should not be regularly added to the program.

Order Points

Rate of use of replacement parts is carefully recorded not only in steam station but other parts of the system. These records are used in calculating order points by the company stores department. An "order point" is the minimum number of spare parts of a particular item that must be in stock at all times. When the number drops to this point an order is placed with the vendor for more.

Thus orders for an item with an order point of ten would be placed when the stock fell to ten. An item would have an order point of ten if the item was used at the rate of five per month and two months was required to deliver ten items. Data on the rate of use of each replacement part are supplied to the stores department by the plant using the item and these data are periodically reviewed by the stores manager in conference with the plant superintendent to correct changes in the rate of use. Delivery rates are, of course, determined by the stores department.

Typical Section From Six-Month Maintenance Schedule, October 15, 1937, to April 15, 1938

TURBINE ROOM

Unit	Description	Men	Days	Man-Days
No. 5 main unit	To be given general inspection and renew the 17th stage spindle blading	10	55	550
No. 4 main unit	Clean generator air cooler	2	6	12
	Clean oil cooler	2	5	10
No. 1 air compressor	Machine valve seats af low-pressure cylinder	2	8	16
Air compressors	Clean valves, intercoolers and aftercoolers. Adjust regulators and keep compressors in normal operating condition	1	52	52
No. 1 house turb	Overhaul valve gear	2	2	4
Drip drain control	Repair S. C. regulator or install new drainage control on No. 1 and No. 2 pit drip receivers	2	6	12
Condenser cleaning	Clean condenser tubes and set up drying equipment	2	15	30
Blr. feed water pumps	Repack all suction and discharge valves	2	3	6
No. 2 sludge pump	Clean and overhaul pump. Last overhauled June, 1930	2	4	8
Turb. room crane	Renew main hoist drum gear and pinion on 110-ton Niles crane	4	8	32
No. 2 raw water pump	Overhaul pump and clean motor. Last overhauled July, 1933	2	10	20
No. 3 raw water pump	Overhaul pump and clean motor. Last overhauled April, 1932	2	10	20
No. 4 raw water pump	Overhaul pump and clean motor. Last overhauled July, 1931	2	10	20
No. 4 R. D. V. pump	Clean valves and water jacket	2	4	8
No. 5 R. D. V. pump	Clean valves and water jacket	2	4	8
No. 6 R. D. V. pump	Clean valves and water jacket	2	4	8
Defective equip. reports	Miscellaneous jobs not scheduled but covered by defective equipment reports	4	130	520
Hydraulic cylinders second section	Repair hydraulic operating mechanism of ten (10) Kennedy valves in circulating water lines to Nos. 3 and 4 turbines. Including reboring of cylinders and fitting with new pistons	4	26	104
Total turbine room		..	..	1,440

Superheater Tubes Protected by Shield

Where operation of soot blowers shows signs of deteriorating superheater tubes, $\frac{1}{16}$ in. spring steel shields are clipped or tack welded to tubes in Cahokia station.

Thus if any destructive erosion takes place it is on the shield rather than in the tube and it is obviously easier to replace the shield than it would be to weld a new section in the superheater tube.

PRIORITIES PROBLEMS

Figuring $500 Limitation

Case No. 23

Often utilities ask WPB's power division how to intepret Paragraph F-3(ii)(c) of Order P-46, limiting improvement of property without prior Washington approval to jobs costing less than a net $500 worth of materials, for a specific project they desire to undertake in connection with maintenance work.

The rules are not hard and fast on this subject; the intention of the provision is to give utilities leeway within specified limits to take those steps that are considered necessary for proper operations.

Take the example of a utility which was planning to replace some old circuit breakers. If these were replaced with new circuit breakers of "like kind" the exchange would involve no improvement, even though the price today of new circuit breakers is higher than the cost of the old. If, on the other hand, new breakers of the same size have improvements in design and operation over the old ones, the difference in cost would be limited to $500.

This utility, however, wanted to install larger circuit breakers because of changed operating conditions. The question was, could the larger units be installed if the difference between the original cost of the old ones and the cost of the new ones did not exceed $500? The answer was, yes.

Another illustrative case involved replacement of a transmission line of No. 2 conductor. The utility said its operations indicated a need for restringing the line with No. 1/0 conductor, but the difference in cost wouldn't exceed $500. Here again the answer was that the proposed job might be undertaken. However, the power division suggested use of No. 2 wire and installation of voltage regulators instead of using the larger size wire, if this were possible, simply to save using an increased amount of copper.

More About Ranges

Case No. 24

What about the family that moves from one house to another and takes its electric range along, then applies to the utility for a third wire extension when there is a gas connection in the house? The penchant of Americans to move about, particularly now when there is considerable labor migration to war centers, creates such instances daily.

Order P-46b, which gives utilities blanket authorization to provide range facilities in certain instances (see Case No. 20, October 17, 1942), isn't broad enough to cover these situations and at present WPB's power division is refusing, in almost every instance, exceptions to the regulation.

Here's a typical sample: In New Jersey a family moved in order to be closer to the man's place of employment—moved primarily because of transportation difficulties. In the area it is customary to rent houses without ranges, so the family brought along its almost-new electric range and asked the utility for third wire service.

But the house had gas facilities already installed, which meant that under P-46b the utility could not make an extension for electric cooking without Washington's approval. An application to the power division for permission to provide the service was turned down.

WPB's rejection of exceptions in these cases is based upon the policy that copper cannot be spared for civilian cooking when the consumer can still obtain another type of service. WPB also turns down permission to lay pipe for a gas range when there is third wire service in a home.

Replacing Inventory

Case No. 25

The provision of Order P-46 which permits utilities to replace inventory up to the dollar value by which sales of stored stocks actually decrease their inventory below a working minimum (Paragraph F-4(vi)) has confused many companies. The provision has a directly opposite effect from the policy WPB has followed since July which permitted utilities simply to offer excess materials for sale, then replenish short supplies of certain needed items.

Actual examples on this subject do not cover all the contingencies, but the following composite analysis of requests for interpretations to WPB's power division is designed to illustrate the problem.

Suppose the utility has $50,000 worth of wire and cable of all kinds and its P-46 minimum working inventory for this class of materials (Paragraph F-2) is $20,000. Under Paragraph F-4(vi) the utility must sell $30,000 worth of wire and cable to other utilities, to a supplier or to some other purchaser with a WPB authorization before it is eligible to use its P-46 ratings to obtain additional stocks of wire and cable.

Often, however, the utility's excess supply of wire and cable will be all of one or two common sizes—perhaps No. 4 hard-drawn copper conductor—while its stock of some size such as No. 8 weatherproof is inadequate even for minimum maintenance operations. In that event the utility is permitted, under Paragraph F-4(iv), to purchase No. 8 wire in an amount up to 5 percent of the total withdrawals of all wire and cable during the comparable 1940 quarter. If more leeway than this is required,

RWPB's POWER DIVISION interprets the phase "extension of a line to consumer premises" (Paragraph B-2(c) of Order P-46) to include an extension to serve a new street-lighting fixture even when the fixture is simply connected to an existing series. Extensions to consumer premises are among the things banned by Order P-46 (except as otherwise authorized)—which means that utilities are not permitted to extend service to a new street-lighting fixture without approval from Washington. Instances of this kind come up frequently in connection with fire hydrants, but there also have been a number of lighting applications reach Washington. Uusually they are turned down.

application must be made by letter to the power division for authority to exceed the order's limit; the letter should set forth the pertinent facts and the need for relief.

This same reasoning applies to each of the other "control groups" on the PD-194 form—generating station materials, switching and substation materials, other transmission and distribution materials, and other materials and supplies. Inventory control under P-46 applies equally to each of these categories of materials which WPB has grouped into "the same class."

WPB's intention is that this policy will stimulate the growing volume of trading of supplies among utilities so as to get already fabricated materials into essential use with a minimum demand upon short stocks of critical raw materials.

Using Frozen Material

Case No. 26

This is the story of how one utility company is building an addition to its power plant with materials originally fabricated to the order of other utilities whose expansion was halted.

When WPB, last summer, curtailed utility power expansion, it halted some projects entirely, while giving others top ratings for hurry-up completion. Some utilities given a green light for their plans, however, found themselves unable to get materials quickly enough to meet construction schedules.

In one case the utility had an AA-4 for a generator installation already under way and scheduled in the WPB program for completion this year. The rating, however, wasn't high enough to get the necessary structural steel—in fact, no rating could get the steel parts fabricated in time to meet the schedule without delaying military orders.

The utility suggested that the necessary materials might be obtainable from fabricators at work on orders for generator installations halted by WPB's action. A survey of fabricators' inventories confirmed the fact that there was a considerable amount of "frozen" equipment already completed and enough pieces were located to fill the utility's entire order by fitting together parts intended for several other power stations and adapting them to the utility's original design.

The power division then told the utility simply to serve its AA-4 rating upon the fabricators with the needed items and delivery was obtained at once. Since the problem of this particular utility has been worked out, the procedure has been used to help another half-dozen utilities get items they also needed from fabricators who had been ordered to halt work for other companies.

Piecemeal Projects Applications

Case No. 27

Utilities planning an expansion of facilities which is to be carried out a step at a time over several months often apply for priorities piecemeal on PD-1A applications covering only the portion of the job to be undertaken at the moment. This is risky, because at any point along the line a PD-1A may get turned down, leaving the utility with a half-completed job, because WPB does not get a full picture of the purpose and need for a particular phase of the undertaking.

A recent substation expansion program illustrates the point. The utility, over a period of months, had obtained individual ratings on PD-1 and PD-1A applications for an extension to the bus, for new circuit breakers and for replacing existing switchgear with larger units, all in anticipation of growing war loads on its system. On the final step in the job, an additional line to tie in to the bus extension, a rating was refused.

The utility appealed to WPB's Power Division, pointing out that the line was an integral part of the program already substantially completed, but without which the improvement would be of little value. After reviewing the circumstances, WPB reversed its finding and authorized completion of the job.

What the utility should have done was to file a PD-200 project application outlining the entire program and showing the need for it, and scheduling delivery of needed materials to fit its plan for step-at-a-time construction. This would have given the Power Division an over-all picture of the job at the outset and where, as in this instance, the project was considered necessary would have given the utility authorization covering the entire job on one application.

Connections Are Not Extensions

Case No. 28

Prohibition of new extensions of service in Order P-46 does not apply to instances where perhaps only a transformer and meter need be installed before energizing existing facilities—so long as the cost of the new equipment is within the $500 limit under Paragraph F-3(ii)(C). Neither does the prohibition apply where increased service can be given with only the installation of equipment other than conductor to carry a larger load.

A recent case in point was raised by a utility which had been asked to provide service for a new commercial enterprise opening for business in an old location. The necessary service drop was in place as well as all other equipment except the distribution transformer and meter. The utility asked WPB's Power Division whether it could install the transformer and meter without specific authorization.

The Power Division's reply was yes, that the new language of Paragraph F-3(ii)(C)—"not an extension of a line to consumer premises"—is intended to make clear that the prohibition applies to stringing a line but not to energizing existing lines if this can be done with installation of less than $500 worth of materials other than a line.

Another similar interpretation has been made in a case involving an application from the consumer to a utility for increased demand which could be served by substituting a larger transformer for the one in use. WPB told the utility to go ahead within the $500 limit.

RUTILITIES CANNOT INSTALL third wire service for electric cooking where gas facilities are available to a residence, but WPB's Power Division does permit transfer of a complete set of materials from one residence to another. In other words, if a family with an electric range moves to a house without third wire service and can bring along the necessary materials to make a complete connection from distribution pole to range, authority for installing the facilities at the new location will be given upon application to Washington in letter form.

Evaluate Ability of 24-Kv. Cable to Stand Emergency Overload

*Detroit Edison emergency overload tests of 24-kv. paper and lead cable reveal ability to stand 150 deg. conductor temperature for 3½- or 15-hour periods without serious damage — Dielectric loss an index of incipient failure**

G. B. McCABE† and JOSEPH STICHER‡ Detroit Edison Company

INCREASING STRINGENCY of materials essential in manufacture of electrical equipment is compelling the fullest possible use of present facilities for the production, distribution and utilization of electricity. It has been a stimulus to utility engineers to wrest every possible kilowatt-hour from installations without jeopardizing future serviceability too much.

This article deals with an investigation that was undertaken by the Detroit Edison Company to determine the maximum allowable carrying capacities of 24,000-volt, three-conductor, paper-and-lead transmission cable.

From this study emergency loadings were established for these cables which, it is felt, they can carry satisfactorily on infrequent occasions without too great a loss of useful life.

Test Findings

The following conclusions and observations were reached from these emergency load tests, which, it is felt, were as severe as any conditions likely to be encountered in the field:

1. A three-conductor, 24-kv. cable (a No. 2/0 AWG belted, a 350,000-cir.mil belted or a 350,000-cir.mil shielded) in a twelve-duct bank when feeding emergency loads for 3½ or 15 hours, depending on the type of substation being served, can go to a conductor temperature of 150 deg. C. without significant harm to the paper insulation. This conclusion assumes that the cable is in the proper condition; also, that four of the other cables in the twelve-duct bank are operating with a sheath temperature of 40 deg. C.; two others with a 50 deg. C. sheath temperature. At such copper temperatures the degree of impregnation is an important factor. Very old service-aged cables or riser cables, with a dearth of impregnating oil, may develop hot spots and fail thermally, while cables too fully impregnated may suffer sheath failures from expanding oil which may drain out and also develop hot spots and thermal failure.

2. Under the conditions of these emergency load tests, internal pressures in excess of 40 lb. psi., in general, appeared to produce sheath ruptures.

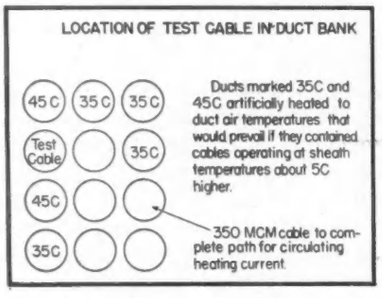

LOCATION OF TEST CABLE IN DUCT BANK
45C
35C
35C
Test Cable
35C
45C
35C
Ducts marked 35C and 45C artificially heated to duct air temperatures that would prevail if they contained cables operating at sheath temperatures about 5C higher.
350 MCM cable to complete path for circulating heating current

FIG. 1—Location of test cable in duct bank

3. Curves of dielectric loss on recording watt-hour meters served as excellent indicators of impending thermal failure. Sharp rises in these curves toward the end of the 3½- or 15-hour period presaged failure had the emergency loads been maintained a little longer.

4. Older belted cables, which have been in service several years, have appreciably higher dielectric losses than the new, unused cables. However, the older cables are no more likely to fail due to higher loss than new cables unless load is increased enough to produce thermal instability. This is manifested by a sharp rise in the dielectric loss curve.

5. Duct splices and normal joints, constructed in a few of the test lengths, withstood the emergency loads satisfactorily. No signs of deterioration in the hand-applied insulation were uncovered and no more than normal deterioration, as evidenced by slight wax and infrequent carbonization, was revealed in the factory insulation within the joint.

6. In many of the tests longitudinal expansion was between 1.5 and 2.0 in. Effect of cable movement of this magnitude is negligible since such emergency loads are not expected to be imposed upon the cables oftener than once in five or more years.

7. Bending tests, performed according to AEIC specifications on samples removed from the various lengths tested, showed that even in older service-aged belted cable edge tears were so few as easily to pass the AEIC specifications.

8. Impulse tests which were conducted on samples of 1941 shielded cable from both the 3½- and 15-hour emergency test lengths showed some reduction in surge strength from the values for new cable. The average breakdown value of 330-kv. for the 15-hour sample was as high, however, as that on three brands of new cable tested in 1938. In the case of the 1925 belted cable there was no difference in surge strength between samples cut from the reel length before and after subjecting to emergency loading.

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* From paper to 1942 fall meeting, E.E.I. Transmission and Distribution Committee.
† Engineer on cable practice.
‡ Research engineer.

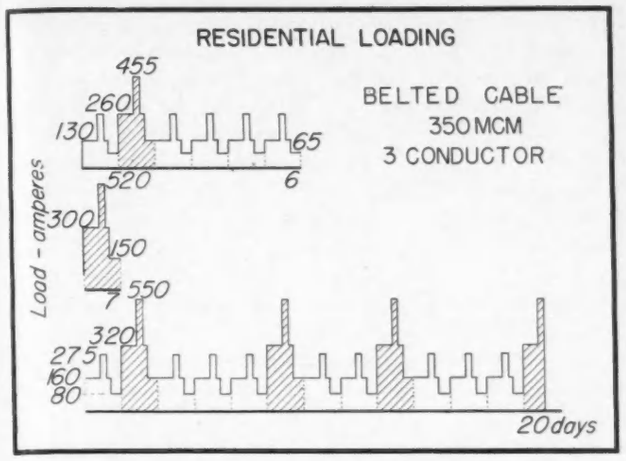


FIG. 2—Type of emergency loading schedule adopted for tests on cable feeding residential load. Schedule shown is that for test sample "D". Note 3½-hr. emergency peaks

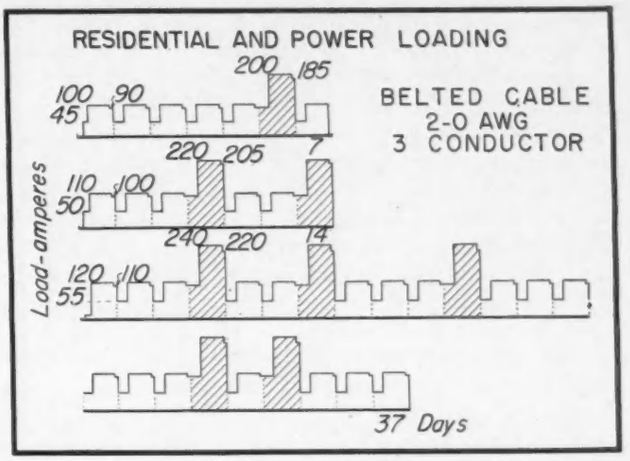


FIG. 3—Emergency loading schedule of the type adopted for combined residential and industrial load. Schedule shown is for sample "F". Emergency peak is 15-hr. duration

9. Because of the non-uniformity of the insulation along the length of some of the older cables, the few radial power-factor measurements made on the paper tapes were of little value.

10. The following emergency loads were satisfactorily carried a minimum of five times in most cases:

Cable	3½-Hour Max. Step	15-Hour Max. Step
No. 2/0 AWG	280 amp.	240 amp.
3-c., belted	11,650 kva.	9,980 kva.
350 MCM	520 amp.	470 amp.
3-c., belted	21,630 kva.	19,530 kva.
350 MCM	600 amp.	535 amp.
3-c., shielded	24,960 kva.	22,250 kva.

11. Taking into account the non-uniformities in operating cable lines and allowing a factor of safety on the above, the Detroit Edison Company has adopted a maximum allowable conductor temperature of 110 C. and established the following ratings for infrequent emergencies occurring not oftener than once in five years:

Cable	3½-Hour Peak	15-Hour Peak
No. 2/0 AWG	250 amp.	210 amp.
3-c. belted or shielded	10,400 kva.	8,700 kva.
350 MCM	465 amp.	420 amp.
3-c., belted or shielded	19,300 kva.	17,400 kva.

These emergency ratings are based on six cables in a 3x4 fiber duct bank, one cable carrying emergency load, with the remaining cables normally loaded. Since many transmission lines contain both shielded and belted cable, ratings are based on the carrying capacity of belted cable. While the selected maximum copper temperature of 110 C. is 40 deg. lower than 150 C., which was found to be safe in several of the tests, the adopted emergency load ratings are still almost 90 percent of the test values. In other words, a relatively large increase in conductor temperature affords comparatively little gain in emergency rating.

12. To provide for emergency overloads occurring as often as once a year, instead of every five years, the Detroit Edison Company has also adopted the following emergency ratings based upon a maximum allowable conductor temperature of 95 C.:

Cable	3-Hour Peak	15-Hour Peak
No. 2/0 AWG	225 amp.	200 amp.
3-c., belted or shielded	9,300 kva.	8,300 kva.
350 MCM	425 amp.	375 amp.
3-c., belted or shielded	17,600 kva.	15,600 kva.

Test Program

This test program was carried out in conjunction with the development, by the Detroit Edison Company, of a method of cooling substation transformers by means of an external water spray which permits emergency peak loads equal to more than twice the normal rated capacity of the transformers to be carried occasionally. For example: A 6,000-kva. transformer, when sprayed with 20 gal. per minute of 25 C. water, carried 12,000 kva. continuously with a maximum average winding temperature of 92 C. Thus, in the case of a substation fed by two fully loaded transformers, one might be removed from service for a 24-hour period and the other made to carry the load of both transformers.

Since these transformers are fed, in most cases, by radial 24,000-volt cables, the allowable loads may be limited by the carrying capacity of the cable as well as that of the transformer. A test procedure, therefore, was developed to determine whether the cable, which is a No. 2/0 A.W.G., three-conductor belted cable in the case of the feed to a 6,000-kva. transformer, could withstand without appreciable damage emergency loads of the order of those satisfactorily carried by the transformer without harm.

About 80 percent of the 300 miles of No. 2/0 A.W.G., three-conductor, 24-kv. belted cable, operating on the system in 1920, is still rendering satisfactory service. Typical lengths of service-aged-cable of the period 1917 to 1920 were, accordingly, chosen for the test. The test was extended to include, besides the No. 2/0 A.W.G. belted cables, 350,000-cir.mil belted and 350,000-cir.mil shielded cables, the 350,000-cir.mil size, which is the present Detroit Edison standard size of 24-kv. cable, being employed as the customary feeders to 10,000-kva. transformers.

Setup and Procedure

A test installation was made in a 100-ft. run of standard 4-in. fiber, twelve-duct bank, 3 wide by 4 high, located in a yellow clay soil on company property at an outdoor substation. To simulate service conditions, test cable was installed in one outer duct and another larger cable was installed in a second outer duct to serve as the return path for the heating current in the test cable. Hotbed cables pulled in six other outer ducts were loaded to give air temperatures of 35 deg. C. in four and 45 deg. C. in two of the ducts. These duct air temperatures represent thermal conditions in the air adjacent to normal cable sheaths having temperatures of

40 deg. C. and 50 deg. C., respectively. An accompanying diagram shows arrangement of cables in the duct bank.

The selected test schedule required the cable to be subjected to several normal daily load cycles, followed by one emergency daily load cycle. This schedule was repeated at least four additional times, providing the condition of the test cable permitted.

There are two different types of loads carried by cables on the Detroit Edison system, one being residential load, the other combined industrial and residential loads. Peak of the residential-type load occurs in the evening after sunset and is usually maintained for three to 3½ hours. Peak of the combined load is maintained at a fairly uniform level from 7 a.m. to about 10 p.m., or a period of about 15 hours. Accompanying curves show the emergency loading schedules adopted for tests on cable feeding a residential substation and for those serving combined residential and industrial loads. The residential schedule is for test sample "D" and combined schedule is for test sample "F."

The three kinds of cable tested were subjected to loadings based on the two load curves, the maximum load steps being maintained for a period of 3½ hours in the residential load test and for 15 hours in the other.

Each test length was terminated with oil-tight potheads. Some of the lengths were made up with duct splices and manhole-type joints in order to ascertain how they would withstand the effects of such high emergency loads.

Ten thermocouples, spaced 10 ft. apart, beginning 5 ft. inside the duct, were attached to the cable to permit temperature measurements along the cable sheath. Additional thermocouples were secured to the riser section of the test cable. Some were placed 25 ft. into the four vacant and six hotbed cable ducts. A thermocouple buried 20 ft. from the duct bank gave ground temperature.

Conductor temperature measurements were obtained from conductor resistance readings taken at the end of each emergency load step.

Readings of longitudinal movement and of pressure inside the cable sheath were also taken at both ends of the test length.

The maximum values attained (during the emergency load cycles) for these various readings of conductor and sheath temperature, internal pressure and elongation per 100-ft. length and ground temperature are shown for each cable sample in the table. The table also records the schedules with the highest emergency load current.

Power factor measurements, employing single-phase voltages between 10 kv. and 40 kv., were taken at various times before and after normal and emergency load cycles. Bend tests and radial power-factor measurements were made on a few samples from test lengths. Impulse tests were conducted on 350,000-cir.mil belted and shielded cables tested.

Test Results

Residential Substation Loading (3½-Hour Peak)

Test sample "A," No. 2/0 A.W.G. belted cable—Cable age, 1917; emergency load cycles, one; emergency current applied, 320 amp. for 3½ hours. This cable failed in the last minute before the end of the first 3½-hour step. It was evident that load was too high for No. 2/0 A.W.G. belted cable of this age and service. Emergency load was reduced to 280 amp. for tests on sample "B."

Rapid rise in curve of the recording wattmeter warned of imminent failure of sample "A." Dielectric loss rose from about 3 watts per foot at start of 320-amp. load to about 55 watts per ft. 6½ minutes before failure.

Examination disclosed the sheath failed at a point where sheath temperature had reached 132.5 deg. C. For 5 ft. on each side conductor insulation and much of the belt insulation was badly charred. Dark brown

Summary of Test Results

Sample No.	Type of Loading	Description of Sample	No. of Emerg. Cycles	Emerg. Cur. Appl. Amp.	Average Temperature C.		Internal Pres. PSI.	Elongation In. per 100 ft.	Ground Temp. C.	Heaviest Sched. of Load Cycles			Remarks
					Cond.	Sheath				Dur. Hr.	Norm. Amp.	Emer. Amp.	
A	Residential 3½ hr. peak	1917, Used Belted 2/0 3-cond.	1	320	226	118	56.0	2.5	19.2	10½ 3½ 3 7	90 160 90 40	185 320 185 90	Failed ½ minute before end of 320-amp. step
B	"	1920, Used Belted 2/0 3-cond.	5	280	139.5 to 153.5	88.5 to 100.1	7.5 to 8.5	1.39 to 1.44	17.5 to 18.3	10½ 3½ 3 7	80 140 80 40	160 280 160 100	Cable did not fail
C	"	1923, Used Belted 350M, 3-cond.	0	Test sample was defective so no results are recorded.									
D	"	1927, Used Belted 350M, 3-cond.	6	1–455 1–520 4–550	106.2 to 162.9	77.0 to 104.6	38.0 to 52.0	0.95 to 1.60	9.2 to 12.5	10½ 3½ 3 7	160 275 160 80	320 550 320 160	Failure in riser 8 minutes before end of 6th cycle
E	"	1941, New Shielded 350M, 3-cond.	6	2–565 4–600	119.3 to 114.6	93.2 to 114.9	23.0 to 40.2	0.97 to 1.15	7.8 to 10.6	10½ 3½ 3 7	160 280 160 80	325 600 325 160	Cable did not fail
F	Res. & Pwr. 15-hr peak	1920, Used Belted 2/0 3-cond.	8	1–200 2–220 5–240	95.9 to 154.3	76.0 to 103.6	2 in. hg. to 5 psi	0.62 to 0.75	16.1 to 17.8	7 15 2	55 120 110	110 240 220	Cable did not fail
G	"	1925, Used Belted 350M, 3-cond.	5	470	118.8 to 143.3	88.9 to 93.1	33.0 to 47.0	1.33 to 1.83	5.7 to 8.9	7 15 2	110 235 220	220 470 440	Failed 18½ min. before end of 5th cy., but not in cable itself. Due to leaky pothead
H	"	1941, New Shielded 350M, 3-cond.	6	2–470 1–520 2–535 1–600	101.0 to 159.4	79.0 to 114.0 (149 Max.)	22.5 to 45.0	1.01 to 1.58	5.6 to 6.1	7 15 2	(120)* 140 (260) 300 (240) 280	(240)* 280 (535) 600 (480) 555	*Sheath failure and hot spot after 11 hrs. of last emergency cycle

* Values in parentheses ( ) are currents during 535-amp. maximum current cycle.

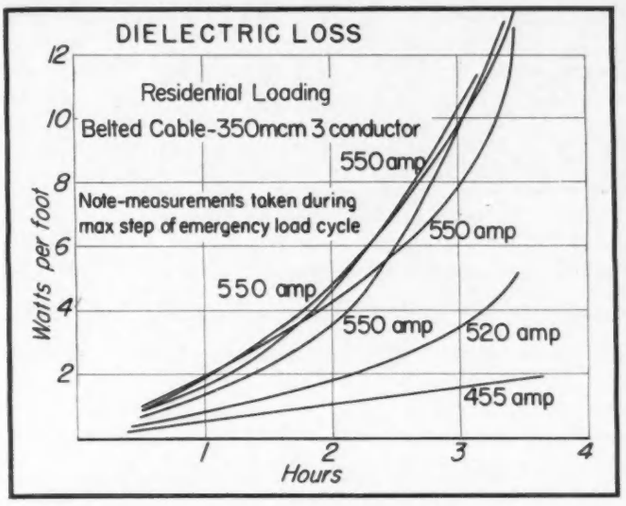


FIG. 4—Dielectric loss curves for sample "D" tested on residential loading schedule. Values of current are maximum steps in load cycle. Note sharp rise in curve for final 550 amp. load peak during which cable failure occurred

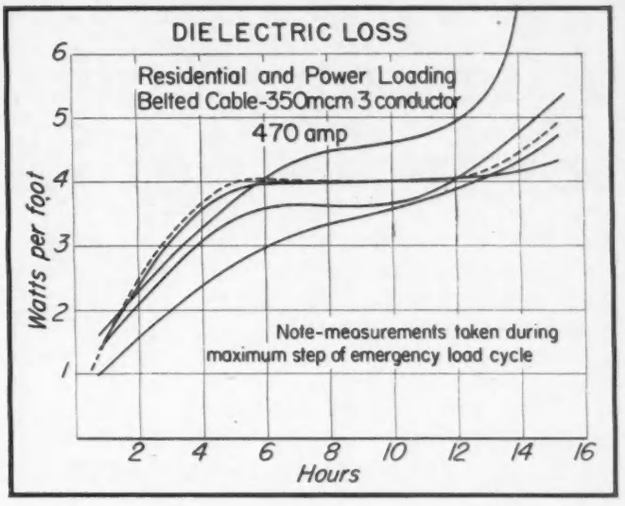


FIG. 5—Dielectric loss curve for sample "G" on combined residential and industrial loading schedule.

Note sharp rise on third and fourth maximum steps and failure on fifth

baked spots in the conductor insulation persisted 12 ft. away from the failure.

Test sample "B," No. 2/0 A.W.G. belted cable—Cable age, 1920; emergency load cycles, five; emergency current applied, 280 amp. for 3½ hours.

Cable withstood this test quite satisfactorily. Maximum cable measurements are shown in the table. Dielectric loss reached a fairly high value at the maximum temperatures attained, but does not indicate any immediate failure. Examination of cable revealed that despite punishment and age it was fit to be returned to service. Insulation tapes were well impregnated and contained no carbonization and but little wrinkling and wax.

Test sample "C," 350,000-cir.mil belted cable—This sample failed at 35 kv. during the power factor test prior to the first emergency cycle due to moisture that had penetrated insulation through an undetected sheath split. On succeeding samples all test lengths were first tested with the kenotron.

Test sample "D," 350,000-cir.mil belted cable—Cable age, 1927; emergency load cycles, six; emergency current applied, one 455-amp., 3½-hour peak, one 520-amp., 3½-hour peak and four 550-amp., 3½-hour peaks.

Cable failed eight minutes before the end of the last cycle in the riser cable 4 ft. below the pothead due to migration of impregnating compound. Examination of samples revealed cable to be satisfactory for return to service.

The dielectric loss curves for this sample are shown. For the four 550-amp. steps incipient failure is indicated toward the end of the 3½-hour periods in each case. Curves for the 455- and 520-amp. cycles on the same graph indicate these currents can be safely carried under these emergency conditions.

Test sample "E," 350,000-cir.mil shielded cable—Cable age, 1941; emergency load cycles, six; emergency current applied, two 565-amp., 3½-hour peaks, four 600-amp., 3½-hour peaks.

Cable withstood test successfully. Examination revealed insulation abundantly and uniformly impregnated; physical properties unimpaired. A cold bend test developed no edge tears whatsoever. Radial power-factor tests of various conductor insulation layers showed no difference between new and tested cables.

A sample taken near point of highest sheath temperature (120 deg. C.) was impulse tested. Failure occurred at 455, 410 and 400 kv. A new sample broke down at 510 and 450 kv. (no oscillogram record on third conductor).

Combined Residential and Power Loading (15-Hour Peak)

Test sample "F," No. 2/0 A.W.G. belted cable—Cable age, 1920; emergency load cycles, eight; emergency current applied, one 200-amp., 15-hour peak, two 220-amp., 15-hour peaks and five 240-amp., 15-hour peaks. Schedule for the 240-amp. load cycle is recorded in the table, as are maximum cable values measured for these cycles. The current was increased to 240 amp. to bring conductor temperature to 150 deg. C.

Sample "F" withstood this test without any trouble. Examination showed it to be in as good condition as sample "B."

Test sample "G," 350,000-cir.mil belted cable—Cable age, 1925; emergency load cycles, five; emergency current applied, five 470-amp., 15-hour peaks.

Leaky capnut gaskets on a pothead allowed enough compound to extrude from riser portion of cable to cause failure 9 in. below pothead during 40-kv. power factor test at end of first emergency cycle. Pothead was rebuilt and a second emergency load cycle applied. Excessive temperatures developed in the riser. It was replaced with a new one connected to the cable by a joint next to the duct mouth. Cable withstood the third and fourth emergency cycles satisfactorily, but failed 18½ minutes before the end of 470-amp. step in fifth cycle. Cable was cut at the joint connecting it to the riser. Kenotron test failed to uncover any fault. Failure was therefore outside the cable itself, probably in the pothead.

Dielectric loss curves, shown, rose sharply on the third and fourth maximum steps and particularly on the fifth. This presaged thermal instability and ultimate failure, undoubtedly due to loss of oil in the leaky pothead. Dissection of the cable in region of highest sheath temperature (102 deg. C.) disclosed cable in excellent condition; abundantly impregnated and relatively free of wax and carbonization. Complete impregnation was possibly responsible for high internal pressures (47 lb. psi.) and in a measure for the leaks in the pothead capnuts.

Cold bend tests in the region of highest sheath temperature produced a few edge tears, but no more than from untested reel sample. Impulse tests caused breakdown on two of the conductors at 330 and 395 kv., compared with 340, 350 and 360 kv. on untested reel samples.

If effect of pothead trouble is ignored this cable can be said to have satisfactorily withstood five emergency cycles of 470 amp. on the 15-hour step.

Test sample "H," 350,000-cir.mil shielded cable—Cable age, 1941; emergency load cycles, six; emergency current applied, two 470-amp., 15-hour peaks, one 520-amp., 15-hour peak, two 535-amp., 15-hour peaks and one 600-amp. 15-hour peak.

The cable withstood all emergency loads but the 600-amp. step, which, because of the full impregnation of the cable, caused a split in the sheath about 6 ft. inside the duct. It appears that a modern 350,000-cir.-mil shielded cable is so fully impregnated that it cannot be subjected to emergency load cycles of 600 amp. without danger of rupturing the sheath.

The 600-amp. cycle, despite sheath rupture, was carried to completion. Sheath temperature near the crack reached 140 deg. C. Much oil was lost for a few feet each side of the break, causing charring of the inner third of the insulation and deterioration and lack of oil in the remaining tapes. Cold bend test on a 15-ft. section starting 5 ft. from the split produced no edge tears in any of the tapes which were in good condition and well impregnated.

Impulse test on a sample next to the bend test sample produced failures at 370, 315 and 310 kv. Although lower than the values of 510 and 450 kv. earlier reported on a new untested sample (see test sample "E") from the same reel, they still are as high as tests in 1938 on three brands of new 24-kv. cable, covered in the minutes of the T and D committee, E.E.I. for May 4, 1938.

Dielectric loss curve at 600 amp. had a sharp rise after ten or eleven hours at the time of sheath failure, showing impending thermal instability. At 535-amp. peak the dielectric loss curves had no alarming rise toward the end of the 15-hour period. It was concluded, therefore, that this cable can carry a peak of 535 amp. for 15 hours through such emergency cycles.

Alternate Materials for Industrial Reflectors*

Characteristics of non-critical materials now being offered as substitutes for iron and steel, principally for industrial fluorescent units, with discussion of baked finishes

E. H. ROBINSON

SUITABLE industrial lighting reflectors may be produced from several different kinds of basic materials, such as wood, wood fibers, paper, cement, asbestos, and various combinations of compounds broadly classified as plastics. Some of these basic materials seemed very good for reflectors, but the problem is availability. Molded plastics, for example, as is generally understood, require critical chemicals, while pressing or molding machinery is made of scarce tool steel. Plywood, especially impregnated, seems well suited for reflectors, but it is a material which is now finding extended use in training planes, sub-chasers, scouting craft, and many other war services.

Other suitable materials have appeared less critical and more readily available. Some of these are:

Wood Fiber Boards—Made by crushing wood into a pulp and then exploding the fibers such as with steam at high pressure. Trade names of some of these are: "S2S Board" and "Reflector Board" of the Masonite Corporation; "Hardboard" or "Duron" of the U. S. Gypsum Co.

Paper—Wood pulp, rag pulp, or a combination of both held with various binders. Examples are: "Insulator Board," Rogers Paper Company, and a corrugated cardboard, Hinde & Dauch Paper Company.

* An abstract of paper delivered at the recent St. Louis Wartime Lighting Conference of the Illuminating Engineering Society. Mr. Robinson is a member of the Nela Park Engineering Department of the General Electric Company.

Relative Characteristics of Some Alternate Reflector Materials

(As Determined by Author's Observations and Tests)

Name of Product	Ease of Shaping and Forming	Ease of Cutting, Drilling & Punching	Hardness (Scratch Test)	Smoothness of Surface	Ease of Finishing (Paint & Baking)	Temperature (For Baking Paint)	Rigidity (Resistance to Bend & Break)	Fire	Water Resistance (To Absorption)	Weight of Reflector (Approx.)		Ease of Packing & Shipping
										48-In. Lamps	60-In. Lamps	
Hardboard or "Duron" Wood Fiber Board U. S. Gypsum Co.	A	A	A	A	A	300° F.	B+	C	B	5 lb.	8½ lb.	A
"S2S," "Reflector Board" Wood Fiber Board Masonite Corporation	A	A	A	A	B+	300° F.	A	C	B+	5½ lb.	9½ lb.	A
"Asbestos-Flector" Laminated Asbestos Paper Philip Carey Mfg. Co.	Formed	B	B	B	Finished	200° F.	B	A	B*	7¾ lb.	14 lb.	A
Asbestos Cement Board Johns-Manville Company	Formed	C	A	B	B	250°–300° F.	B+	A	B	11 lb.	14 lb.	C
Asbestos Cement Board Keasby & Mattison Co.	Formed	C	A	B	B	300° F.	B+	A	B	11 lb.	14 lb.	C
Type #1895 F Raybestos-Manhattan, Inc.	B	A	B+	A	B	300° F.+	A	A	B+	5 lb.	9 lb.	A
Corrugated Paper Hinde & Dauch Paper Co.	B+	A	C	B	B	150° F.	B	C	C	3½ lb.	4½ lb.	A
Lignin Lignin-Laminated Paper Marathon Chemical Co.	Formed	B	A	A	B	180° F.	A	C	B+	6 lb.	10 lb.	B+
"Panelyte" Laminated Paper Plastic St. Regis Paper Co.	Formed	B	A	A	B+	300° F.	A	B	A	.....	.....	B+
Insulator Board Laminated Paper Rogers Paper Mfg. Co.	A	A	C	C	B	300° F.	C	C	C	5 lb.	6½ lb.	A
"Textolite" Laminated Paper Plastic General Electric Co.	Formed	B+	A	A	B+	250°–300° F.	A	B	A	2½ lb.	5 lb.	B+

* Water absorption in normal amounts is of little practical consequence. A — Excellent. B+ — Very Good. B — Good. C — Fair.

Laminated-Paper Plastic—A laminated structure consisting of paper bonded with a synthetic plaster resin or a natural resin. Examples are: "Laminated Textolite," General Electric Company; "Micarta," Westinghouse Company; "Panelyte Board," St. Regis Paper Company; "Lignin Laminated Plastic," Marathon Chemical Company.

Molded Cement Asbestos Board—Of which a wide variety of combinations are possible, comprising cement, asbestos and other earth minerals either alone or in combination. Some of these are: "Careystone," Philip Carey Company; "Asbestos Cement Board," Keasby & Mattison; "Transite," Johns Manville Corporation.

Asbestos in Laminated Sheets—In combination with cement, paper, lime or gypsum, such as "Asbestos-Flector," Philip Carey Company, and Type 1895 F, Raybestos-Manhattan, Inc.

No two of these materials have exactly the same characteristics. From some standpoints one material may be ideal, but it may be lacking in some important qualification. Compromises, therefore, may be necessary. The table sums up in a relative manner a number of these properties of several likely alternate materials.

Reflecting Surfaces

For a long time vitreous porcelain enamel on steel has been virtually the standard finish for industrial lighting reflectors. Lately there have been new developments in synthetic baked finishes, and some manufacturers have used these on their steel reflectors or have offered them as alternates to their vitreous porcelain enamel, usually at a lower price. With the new alternate reflector materials mentioned above, it obviously is necessary to use these newer baked finishes.

The degree to which these new baked enamel surfaces will maintain their high reflection factors over a period of years in service is not completely determined as yet, but indications are that some are reasonably satisfactory and will stand considerable washing and cleaning. At least one manufacturer guarantees against any yellowing or general surface deterioration. However, the surface is not as hard as the vitreous porcelain enamel.

The application of the baked finishes usually involves no great difficulty. The paint manufacturer should, of course, be consulted as to the technique of application. Many of these finishes can be baked effectively and economically by the infra-red process. At Nela Park, for example, we have a simple experimental infra-red oven and with it have been able to turn out very creditable white-finished samples having initial reflection factors of the order of 89 percent.

When it is recalled that the usual standard figure for white vitreous porcelain enamel is 78 percent reflection factor, it will be seen that the synthetic finishes, at least the better ones, start off with a considerable advantage. However, it should be pointed out that the ability to maintain a high reflection factor in service is even more important than initial reflection factor. Users should assure themselves on this point before adopting a particular finish.

It is, of course, important that the temperature required for baking the white enamel does not exceed a value which the reflector material will withstand. Many so-called high-bake synthetics require a temperature of the order of some 280 to 325 deg. F. This does not affect some of the alternate materials, but, as will be seen from the table, certain of them will require low-bake finishes.

• • •

Chart Records Soot Blower Troubles at Spy Run Plant

Record of soot blower maintenance work done on individual boilers at the Spy Run plant of the Indiana Service Corporation, Fort Wayne, is kept on a form of the type illustrated and used as a guide to the programming of preventive maintenance. As shown, the form provides space to record the date and work order number on brief description of each maintenance job.

Each of the seven soot blower locations is indicated on the boiler drawing and the "record-of-maintenance" table is set up so that work on the blower head, element or hangers can be separately noted for each blower in the left and right hand boiler sections.

This record is reviewed periodically by the plant engineers to detect recurring cases of trouble and to guide them in taking steps to forestall its repetition.

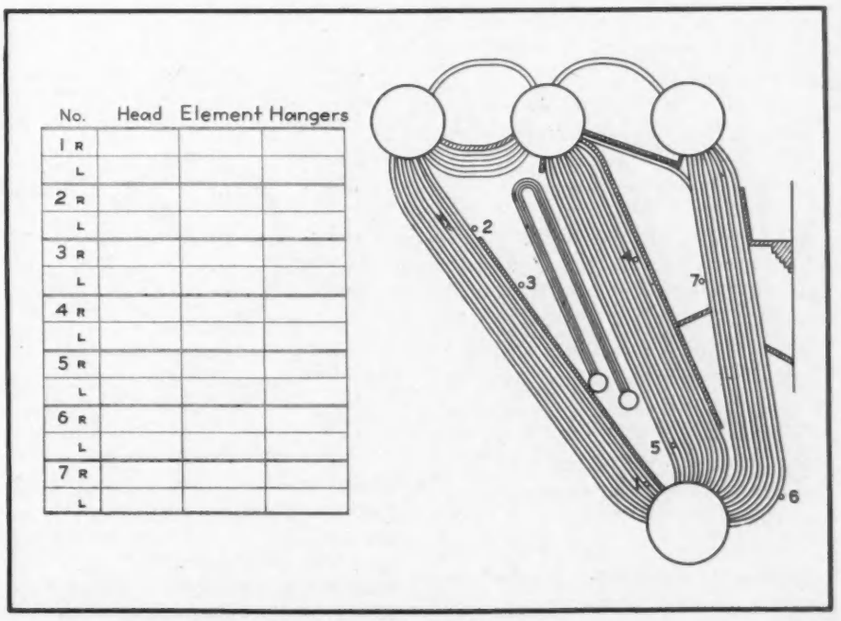


CHART-DIAGRAM keeps record of maintenance work on soot blowers for use in scheduling preventive maintenance

Ichthyological Terminology in the Fish Business

Some pertinent and impertinent observations inspired by reading 45 or 50 utility annual reports and getting pretty tired of the esoteric words and phrases that conceal their meanings

GEORGE KERR, Ebasco Services, Inc.

WE COMPLAIN bitterly that the public does not understand us.

But how can people understand us when they don't understand the words we use—when we don't "speak their language," but, instead, speak our own language; when we insist upon calling a mackerel a *scomber scombrus*.

This business was founded by engineers, fostered by lawyers and accountants, nurtured by bankers, and is shot through, laden, saturated and befogged with technical, scientific, legalistic, financial and accounting terminology, phraseology, nomenclature and etymology which we glibly toss about among ourselves—which is all right.

But it's not all right to keep on doing it in front of other people.

Trying to Impress

It's not so good for what is called "public relations." That is, the right kind of public relations. It gives the impression that we're trying to impress listeners or readers with their lack of knowledge of the complexities and intricacies of our business and surround it with an aura of mystery. Trying to put it (and ourselves) on a high plane far above the common herd.

We write articles and make speeches to ourselves; public relations "counsels" and other experts on the subject write articles and make speeches to us, saying all we have to do is tell our story. "Give the people the facts about our business," they say. "Then we shall be understood and thought well of and held in the high esteem we so justly and richly deserve."

So——we set out to tell our story. And we do it in the fashion of a Rhodes scholar writing a treatise for the consumption of other Rhodes scholars.

Take, for instance, our biggest stock in trade—that of which we sold 34,697,287,315,798 last year—the humble kw.-hr.

That's the way we write it most of the time—just kw.-hr., thinking in our sublime complacency that "they" know kw.-hr. stands for kilowatt-hour.

WHAT IS A KILOWATT-HOUR?—The AMOUNT of current needed to burn ten 100-watt bulbs for one hour (or anything else using 1,000 watts for an hour)—that AMOUNT of electricity is a kilowatt-hour. The kilowatt-hour is simply a unit of measurement, just like pound, ton, yard, dozen, quart, etc.

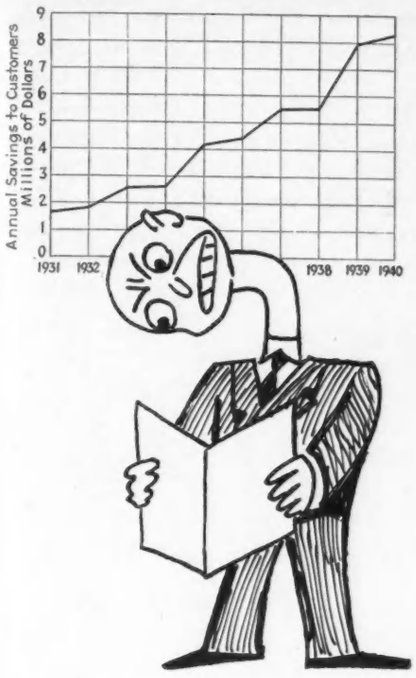
Answer! Quick!

How many of us right in the business (not to mention the public) can give a quick, clear, concise definition of a kilowatt-hour? (as invidious and insidious a piece of hyphenated, polysyllabic, polyglot befuddlement as was ever concocted.) Why, it ought to be as common as an old shoe! It ought to "register" as quickly as "a pound" of coffee, a "dozen" eggs or a "ton" of coal or a "quart" of milk. So we go to give a definition of a kilowatt-hour and start off something like this: "Watt is a term which indicates a rate of energy flow of one ampere of electricity at a pressure of one volt and if this rate of flow continuous for one hour the amount of energy produced or used is one watt-hour. Now kilo is the Greek word for a thousand."

And at this point there bursts out a pent-up interjection,

"Yeah! It sure is all Greek to me!"

Not to be destructive in our criticism, we offer a neat little definition of our meal-ticket in the accompanying etching of scintillant lamps around a clock face with one hour blacked out. Just try it on the next one you meet—provided it's not an



engineer. It's not necessary to carry a clock and ten bulbs around with you.

Then how about the place where the kilowatt-hour comes from? We have a good name for that, too. A "steam electric generating station." A station! Why, that's where you go to get the 5:15 train.

Let's look at it from another angle. You're going through the country or a city or town and you ask "what's that big building." You are told "why, that's the —— soap factory" or the —— shoe factory, or the —— pencil factory, etc. Places where soap comes from, or shoes come from, or pencils come from. Did any one ever point out to you an electricity factory? If they did you'd know immediately it was a place where electricity comes from. You'd know right away what they meant. And that is really all a name is for, anyway. But we not only call our factory a "station" but on top of it we call it a "steam electric generating station." Are you in the steam business too? Do you make steam there for people to buy? How do "they" know we mean steam-driven? It is not advocated here that we substitute "factory" for "generating station," but for general purposes and for the general reader it is clearer to say simply "electric power plant."

We feel we have made great strides forward in "dramatic presentation" when we print something like this—and say, "As shown by the curve above ——" (Actually it's some where on this or another page. You can tell it by the guy with the crick in his neck.)

Curve! What curve? Why, there's not a curve in it. The whole thing's made up of straight lines and angles!! Then look at that business at the left—printed sideways and causing the reader to become a contortionist and twist his neck sideways to read it. Sure it takes more space to print it horizontally. But the way it is now is an irritation to the reader.

On this page are a few "scomber scombri" culled from annual reports and to the right of each is an attempt at more understandable wording.

Suppose we end with a "golden text":

"So also ye, unless ye utter by the tongue speech easy to be understood how shall it be known what is spoken?"

"If then I know not the meaning of the voice, I shall be to him that speaketh a barbarian, and he that speaketh will be a barbarian unto me."

1 Corinthians XIV: 9 and 11

FOR A BETTER UNDERSTANDING

Don't Say	but	Do Say
"Disposition of revenue"		Where the money went.
". . . your company's load"		The amount of electricity your company is called upon to deliver.
"Cost per kilowatt-hour of residential service"		Price per kilowatt-hour to household customers.
"Electric generating station"		Electric power plant.
"Average residential electric rate"		Average rate for electricity to household customers.
". . . the load requirements"		The amount of electricity your company was called upon to deliver.
"This integrated system is further interconnected"		A unified system with additional sources of electricity by reason of the connection of its lines with the lines of neighboring electric companies.
"Spent for maintenance"		Spent to keep the property in efficient operating condition.
"Electric energy"		Electricity.
"Annual 60-minute peak load"		The greatest amount of electricity we produced in one hour during the year.
"60-kv. loop transmission lines"		60,000-volt lines constructed in the form of a loop or ring around a city or similar service area so as to provide service at various points on the loop from either end.
"Total energy sales"		Total sales of electricity.
"Increase of customer's residential use to a point more than twice the national average"		Increase of the average household customer's use of electricity to more than twice the quantity used by the average household customer throughout the nation.
"Annual kilowatt-hour use"		Amount of electricity used per year.
"Distribution of energy"		Delivery of electricity.
"Transmission lines"		High-voltage lines for delivering electricity over long distances from power plant to distribution center.
"Distribution lines"		Lower voltage lines for delivery of electricity from distribution center to the customer.
"Comparative statement of income"		Our 1941 business compared with 1940.
". . . attempted to build a more diversified load"		Attempted to get business from a number of different classes of customers rather than a large amount of business from just a few classes of customers.
"Average use of service was more than twice the national average"		Average amount of electricity used per customer was more than twice the average amount used per customer throughout the nation.
"Commercial customers"		Stores, offices and similar users of small amounts of electricity for power as well as lighting.
"Service area"		Where we do business, or where the company supplies electricity.
"Distribution equipment"		The equipment used, such as lines, poles and transformers, to deliver electricity to customers.
"Transmission service from central stations"		Transporting electricity from power plants to distribution centers.
"The art of generation, transmission and distribution of electric energy"		The production and delivery of electricity.
"New money"		Additional funds for investment in the business, or more money for investment in the business.
"Promotional residential rate"		A rate which encourages more liberal use of electricity.

Editorials

S. B. WILLIAMS, *Editor*

Ability to Consume Leveling off

WHILE the question of whether or not there will be a power shortage is still academic, one cannot help noticing the unmistakable trend of the weekly output curve. The peak of acceleration occurred a year ago, and since then the weekly increase over last year has very definitely been getting smaller. In some sections, like the East, the difference between this year and last is extremely slight. In fact, it would not be surprising to find within the next six months instances of regions turning out less energy than in corresponding weeks twelve months previous.

This is made clearer by the news from Washington that certain war production programs were being modified. Any considerable modification without the release of raw materials for other production would have a definitely unfavorable effect upon energy generation.

Therefore, the thing that we have been stating, and which brought us into sharp conflict with FPC and other harbingers of power shortages, is beginning to show itself, namely, that power shortages are predicated not so much on the inability to supply as upon the inability to consume. Our inability to ship and use munitions will limit our ability to consume power to make them, while our raw material supply is our limit to produce anything.

Substitute Materials for Industrial Reflectors

THE long-expected order forbidding the use of steel for industrial fluorescent lighting fixtures announced last week is tantamount to an admission by WPB that reasonably satisfactory non-metallic reflectors are now available. The relative characteristics of some of these materials are given elsewhere in this issue.

Any difficulities with respect to paint, moisture absorption and warping will in all likelihood be overcome reasonably quickly. Since steel is still available for channels and hangers there is no strength problem. Nor is there any fire hazard. In fact, some of the substitute materials may easily become permanent, and the question is being asked if the substitute reflectors may not have other profound economic effects. Steel was shaped by the reflector manufacturers, but these substitute reflectors, we understand, are formed by the raw material producer. Is this going to open the gates to a flood of new manufacturers with nothing but an assembly bench?

A large part of the development of factory lighting can be attributed to the industrial reflector manufacturers who have promoted individually and collectively better lighting standards. We hope that any change in methods of reflector manufacture will in no way interfere with the progressive development of the lighting art.

Some Good and Some Not So Good

IS THE TIDE turning? Three times within the past few weeks Congress has done something favorable to utilities. It recognized the unfair burden which the tax bill was placing on utilities and gave a measure of relief in allowing preferred dividends as a credit in calculating corporate surtaxes. Congress also threw out the La Follette amendment to the tax bill which would have stimulated municipal ownership, and as a full measure to its beneficence it refused to take rate determination out of the hands of state commissions and give it to OPA.

While Congress takes much of its direction from the administration, it does not follow that it did so in these three instances. In fact, in two of them Congress opposed the proposals of people well up in the administration. All of which makes the actions of Congress even more remarkable.

One cannot make of this probably anything more than three isolated incidents. In the meantime elements within the administration are continuing to wage war upon the electric utilities. It is immaterial to them that in so doing the war effort may be hurt. They do not care if regional integration of power for war is knocked into a cocked hat, provided they can break up any activity on the part of private companies that would weaken the federal power story. They do not care if materials are short so long as construction of federal power projects is continued. They do not care if the Army needs engineers badly so long as they can have the thousands necessary to prepare original cost records.

And the President questions the sincerity of others in the all-out war effort when he can't, and probably doesn't try to, keep his own official family in order.

Producers Can Help Users

COOPERATION in war effort is no better shown than by a growing spirit of helpfulness on the part of producers toward the users of their products, particularly when there is nothing new to be obtained except on the highest priorities. Auto and tire manufacturers have been doing a superlative job of educating the public how to make autos and tires last longer; the telephone industry is teaching subscribers how to make the service suffice for the demand on it, and so on. Electrical supply and equipment manufacturers are moving in this direction, but they can do still more to cement their relations with users who

face the necessity of making everything carry more load longer while doing without customary and familiar aids to maintenance.

Utility and industrial plant electrical engineers alike are shorthanded and confronted with using methods of expediency, alternative designs and substitute materials. They are proving exceedingly ingenious and courageous in devising practices that never went in more serene times. ELECTRICAL WORLD's May 30 issue was concentrated proof of that. But, no matter how clever and resourceful they are, they appreciate all the added clues and guidance that come to them from manufacturers. What do they want to find on any page of their favorite journal, whether it be the editorial pages or the advertisers' pages? Helpful suggestions on how to get along successfully with primary reliance on present facilities are one need. Another is news about equipments they can still get with relative ease.

It's the former of the two needs which is likely to be overlooked in the fever of coaching on priorities and hustling deliveries. But—if a transformer or bushing manufacturer knows of several degrees of thoroughness of checking insulation quality of equipment in service, why not tell of them so a hard-pressed user can apply each most advantageously to keep the equipment working longer? Maybe a wire manufacturer could list and picture equipment useful in salvaging wire. A meter manufacturer could tell what solvents and detergents can be used to remove tape from coils or gummy oil from demand registers. What corrosion preventives could be suggested for boilers not fed with favorable water? How much can the 1925-1940 apparatus of each type designation be crowded for output? What substitute materials have been incorporated and, frankly, how much better (or worse) are they than the accustomed material?

Thus, there are many kinds of service for which the user and reader would be grateful to the maker of equipments and supplies. That gratitude would classify itself in the mind of the user as an appreciated effort toward cooperation with him. Cooperation and mutual helpfulness to get today's tough electrical tasks done are what will squelch the disturbers of international tranquillity and not pictures of rampant eagles or of battlewagons plowing mighty seas.

Uniform Interpretation of Dimout Rules

IT LACKS one month of being a year since we entered the war and still we are fumbling around on blackouts and dimouts. Perhaps we should be thankful that the Army is making no move until, through exhaustive tests, it first is sure of itself. That practice is commendable, but in the meantime so much is left to the interpretation of local defense people that the confusion in some instances is worse than an official error. The latter, at least, can be corrected quickly.

A set of rules that minimize interpretation are all drawn up, but for some reason have not been issued. They are sensible and permit a level of illumination under proper shielding conditions that is reasonable. The lay civilian defense authorities should have no difficulty in following these rules.

In more than one community civilians, perhaps charged with a sincere zeal to achieve a compliance record for their community, have looked upon any visible light outdoors as an offender against public safety. The result has been an insistence in instances upon extinguishment that not only did not contribute to greater safety, but quite the contrary.

If we have any official standards that will cut down this confusion, let's get them in practice at once. If some one is waiting to get them perfect, let him remember that there is no such thing as perfection. Give the standards to us now and let the future determine the spots that need strengthening.

War Removes Restrictions on Wiring Progress

BECAUSE it is very unpatriotic at this time to fight against methods that show savings in critical materials the war is making tremendous progress in progessive wiring practice. When the truth is said it must be admitted that some of these methods would normally have difficulty in getting National Electrical Code recognition, not because they lacked merit but because they might compete with and thereby contract the market for some other interest.

In addition to the acceptance that has been given to covered neutral and to radial and network forms of industrial wiring, we can expect to see other methods advanced. Bare neutral is still being promoted. Cold cathode and high voltage series lighting are being seriously considered as copper savers. If their performance in test installation is satisfactory we can expect to see more usage.

It is a shame, however, to see how hesitatingly engineers advance new wiring ideas. The reason, of course, lies in the sad history of getting N. E. Code approval for anything new. Even now, when the war material conservation program can be advanced, people hestitate to run the code gantlet.

In some ways, of course, this can be considered advantageous to the public in that nothing is accepted so long as its safety is in doubt. There would be greater conviction to this idea, however, if the N.F.P.A. electrical committee had any well-founded notion of what constitutes minimum safety. To establish factors of safety without first knowing what is minimum safety is in effect to acknowledge that they are factors of ignorance.

It would be well if accurate records were kept of all installations of these new methods as well as of materials involving substitutes or lowered standards. Data on their performance might go far after the war to break the stranglehold of commercial compromise upon progressive wiring development.

Washington Comment

GEORGE E. DOYING, Jr., Washington Correspondent

Toward Leaner Inventories

UTILITY INVENTORY is headed for a major pruning, and utilities can anticipate a growing necessity for self-sufficiency in carrying on their wartime construction with materials already in stock.

These twin policies go hand-in-hand with the sharpening of WPB's determination to put all critical materials into war work, converting them from whatever form they are now in to something which is more vitally needed without much regard for the dollar cost of the transformation. The job of doing this has been handed to a recently established agency within the WPB framework, the Materials Redistribution Branch, which is charged with supervising and directing, if necessary, the operations of the industry and commodity branches in this field.

WPB's power division is, in a way, on the spot in this situation at the moment. Either it must get its own program toward these objectives underway effectively and quickly or face the risk that other forces within the Nelson organization will take over the job.

A Covetous Eye

Utility inventories have long seemed to some units within WPB to be a juicy plum ripe for picking. For a long time, however, the power division has generally held the view that this stockpile of already-fabricated equipment should be held intact for gradual absorption into wartime operations, and the branch has been able to make its idea stick. This viewpoint has been undergoing a modification until now there is a growing feeling that perhaps the power division has not kept up the pace.

The recent action of a metropolitan utility came as something of a rude jolt to the "hold-inventories-intact" school. This company urged that WPB either find some immediate use for a long list of materials it had in inventory or permit them to be junked so that the company could strip its warehouses of equipment stocked for normal operations to make room for items needed for changed wartime conditions. The list of equipment totaled almost 50 per cent of the company's P-46 inventory.

Granting the premise that perhaps it has not been "tough enough" about inventory, the power division is planning to demonstrate that it can and should continue to handle the assignment, on the theory that the job can best be directed on an industry level rather than as an indistinguishable part of an over-all program.

Cleaning-Out Coming

In the offing, and likely to materialize rather soon, is a horizontal order to utilities to get rid of everything in their inventories, and in plant accounts as well, for which no use is presently foreseen under wartime operations. Special purpose and obsolete material and equipment, with little regard for age and condition, will be ordered into the scrap pile, or returned to manufacturers for salvage of those parts which can be reassembled into usable apparatus.

This scrap program will be designed to "take the fat off" present utility supplies—fat which for the most part is artificial because it bulks large dollarwise but has little or no useful future, at least for the duration. Yet in WPB, this material is seen primarily as a "mine" of vital copper, steel etc. which could be reclaimed for war duty.

Financing of this program has not yet been worked out. It is inevitable, however, that some arrangement will be made to have the Government, probably through one of the Reconstruction Finance Corp. subsidiaries, buy equipment having an unusually high cost ratio to scrap value and absorb the losses. For salvaging idle plant facilities where removal cost far exceeds the material value, the RFC's Materials Redistribution Corp. already is in the picture and the power division likely will seek a working alliance permitting a determination in individual cases as to whether material should be pulled out for scrap or removed to fill a need elsewhere.

Once stripping down of inventories and plants to useful essentials is defined and underway, WPB is certain to expand greatly its as yet rather modest program of requiring that construction and as much maintenance as possible be accomplished by using already fabricated equipment either in the individual company's own storeroom or available from a neighbor. The requirements in the new Order P-46 that utilities obtain at least 75 per cent of their wire and cable through interchange and restricting use of ratings for obtaining new supplies until excess stocks are disposed of are only first steps which point the way.

Much growth toward self-sufficiency can be accomplished through handling of priority applications in Washington, by limiting authorization to use of available materials and by assisting utilities to locate needed equipment from other companies' stocks. Controls considerably more formal and rigid than the voluntary programs now in operation are expected to develop, however, as this policy ripens. Probably not far away is the time when utilities will have to certify that they cannot obtain specific items before they will be eligible to use priority ratings to purchase supplies requiring new raw materials.

Clearing Houses

Under the power division program, inventories would remain undisturbed physically and controls over interchange would be accomplished through "clearing houses" keeping records of what equipment is available in each region. The alternative is some sort of Government purchase of inventory and a subsequent redistribution of equipment back to utilities as needed.

In either event, however, these controls ultimately will probably be administered by regional offices staffed with WPB personnel. As an interim step, WPB may turn to individual companies in each regional area, asking them to assume the clearing house job as "'agents" of the War Production Board.

NEWS OF THE WEEK

WPB Further Curtails Federal Power Projects

New order halting construction on all non-essential government construction includes many projects not affected in last August's ban on new power expansion

WPB has ordered an immediate halt in all non-essential government construction. In the power field this means that federal projects allowed to continue operations with materials on hand under A-6 or lower ratings in the order curtailing power expansion last summer (ELECTRICAL WORLD, August 29, page 3; September 12, page 3) will now be stopped entirely; also, in all probability, several generators and dams included in the August program will be abandoned for the duration as a result of the new tightening-up policy.

No List Published

In announcing its "stop-construction" action, WPB did not make public a list of affected projects pending a final determination as to their actual relationship to military needs. It was indicated that the Bureau of Reclamation will urge that some of its non-excepted projects be allowed to continue. Among these, it was understood, is Keswick Dam, which was earmarked last August for completion and installation of two of three generators, but dropped entirely from the approved list in the recent order.

The bureau announced that WPB's notice of the stop order excepted these projects: Parker Dam, four 30,000-kw. units; Boulder Dam, units A5 and N7; Shasta Dam, units Nos. 3 and 4; Green Mountain Dam, two units totaling 21,600 kw.; Grand Coulee Dam, units Nos. 4, 5 and 6 and two 75,000-kw. units previously shifted from Shasta. This is the same list of reclamation projects which Secretary Ickes announced as having got the "green light" in WPB's August power program, except for Keswick and unit No. 5 at Shasta, now also apparently dropped.

Tennessee Valley Authority announced that under the WPB order it was immediately abandoning for the duration the Wautaga and South Holston dam projects which had been proceeding on A-6 ratings under the August program. Neither of these dams was scheduled to get generators under the previous power expansion schedule, however.

Other TVA generator units dropped from WPB's August program apparently are continued in the "stop list" by WPB's latest action, and it was understood that dropping of one or two additional units may be decided upon later.

The U. S. Army Engineers did not comment upon WPB's stop order other than to say that work would continue only on projects approved in August unless contrary instructions were received.

SCRAP CALLS CAMBRIDGE UTILITY— Co-operating with the nation-wide scrap campaign, Cambridge (Mass.) Electric Light Co. takes down an ornamental fence bordering the roof top of its Blackstone Street steamplant for conversion by Uncle Sam into metal visting cards for use against enemies. The fence yielded 17,465 lb. on removal. Left, Gustav Brolen, chief engineer of the station

To Allow Appeals

WPB's order was aimed primarily at federal construction outside the power field, inasmuch as the power program previously had been culled down and non-vital jobs limited to operations which could be carried on with equipment and materials on hand. Chief effects of the new action will be to stop some of these projects more quickly and to make possible a further relatively small scaling down.

Appeals from the stop order will be considered by a newly-created WPB Facility Clearance Board, consisting of ranking officers from the Army and Navy, and representatives of the Maritime Commission with Ferdinand Eberstadt, vice-chairman of WPB, as chairman.

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Correction on P-46 Order

The new WPB order P-46 limits deliveries and withdrawals of transmission and distribution materials during any quarterly period to 15 percent of a utility's total 1940 withdrawals of mate-

rials of the same class. The provision requiring that 75 percent of materials come from the inventories of other utilities, however, applies only to wire, cable and busbar—not to all types of transmission and distribution materials as was stated in ELECTRICAL WORLD October 17, 1942, page 69.

Paragraph F-1(i) of the order relating to permitted deliveries reads: "In the case of electric power producers (a) 15 percent (of 1940) as to transmission and distribution material, provided that not less than 75 percent of all scheduled deliveries of wire, cable and busbar shall be from the inventory of another producer.
(b) 25 percent as to all other classes of material.

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Southwest Power Pool Hearing November 17

The Federal Power Commission has postponed to November 17 the hearing previously set for November 2 pursuant to an investigation instituted by the commission on its own motion of the rates and charges involved in a ten-company power pool, known as the "Southwest Power Pool," to furnish electric energy to the Defense Plant Corp.'s Lake Catherine aluminum plant in Arkansas. The hearing was postponed at the request of eight of the ten companies in the pool and will be held in Room 521, Federal Building, Little Rock, Ark.

FPC to "Oversee" All U.S. Power Contracts

President Roosevelt puts into operation policy of war plants contracting with cheapest power source, using "common carrier" transmission—Abrogates WPB-FPC "treaty"

The Federal Power Commission has been formally designated by President Roosevelt as "overseer" of all government contracts for war power supply. The action puts into operation the President's "suggestion" that war plants and establishments contract directly with the cheapest power source, using "common carrier" transmission over other utility lines if necessary to reach the consumer (ELECTRICAL WORLD, October 17, page 71).

President's Instructions

The President's instructions to FPC direct the agency to:

1. Review all power contracts proposed by the War Production Board, War, Navy, Maritime Commission, National Housing Agency or Defense Plant Corp.

2. Determine whether cheaper power supply is available and how it can be delivered, and to issue necessary orders to provide for the cheaper supply "after consultation with the War Production Board as to priorities and allocations."

3. Determine whether—in instances where cheaper sources are not available—rates and conditions of proposed contracts are reasonable and, if unreasonable, to fix proper rates and terms.

4. Review and renegotiate existing contracts following the same procedure.

The President's action came in the face of reportedly strong recommendations by WPB that if any such policy was to be effective it should be administered within the framework of the April 30, 1942, "treaty" between WPB and FPC which gave the former full jurisdiction over power supply for war plants. In view of WPB's stand and the fact that the President failed to mention the "treaty" in his instructions to FPC, the White House instructions are considered tantamount to a major revision of that agreement.

Immediately after receiving the instructions FPC scheduled a commission meeting to work out regulations and procedures for putting the policy into effect. Representatives of affected agencies were invited to the meeting. The commission also moved to make its formal investigation of the Southwestern Power Pool contract with Defense Plant Corporation for service to the Lake Catherine, Ark., aluminum plant, the first renegotiation case under the new policy.

White House release of the President's instructions to FPC disclosed that Mr. Roosevelt had written the affected war procurement agencies on September 26, outlining his "cheapest power source" policy and asserting that there is no reason why "companies not themselves having sufficient power to supply war plants should be purchasing power from neighboring public power agencies for resale to these plants at a substantial profit." The President's instructions to FPC were dated October 22, after he had received replies, including counter-proposals, from procurement agencies.

NEW PHILADELPHIA CABLE LINE—Philadelphia Electric's bulk power transmission system, carrying power for war industries, will soon be reinforced by the completion of the first 69,000-volt oil-filled cable line installed in the territory. Photo shows workmen greasing cable as it is pulled into the duct line at the substation terminal. In foreground is Herman Hahn, supervising engineer of General Cable Corp., who supervised installation of 50 percent of the line; other 50 percent was G.E. cable

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Will Supply Pipeline

Arkansas State Utilities Commission has granted the Arkansas Power & Light Co. authority to supply power to four pumping stations on the El Dorado-Helena pipeline. Two rural electric co-operatives whose territory would be traversed by the transmission lines to two of the pumping plants (ELECTRICAL WORLD, October 10, page 10) have waived their rights.

Distribution Engineers Trade Operating Ideas

Round-table discussions of the E.E.I. transmission and distribution committee, meeting at Cincinnati, bring out a wealth of war-aiding ideas

A wealth of war-aiding ideas was heard by a hundred or more participants at the round-table discussions of the E.E.I. transmission and distribution committee at Cincinnati, October 19 and 20. Numerous measures to conserve copper, steel, rubber and oil, along with further ways to draw upon reserve capabilities of systems, were presented.

Report on Cable Tests

Tests reported by G. B. McCabe on 24-kv. cable showed (see page 70, this issue) ability of the paper to stand 150 C. conductor temperature 3½ to 15 hours without serious injury. Nitrogen gas at 1 or 15 psi. is being used experimentally to rejuvenate 15-kv. solid cable of 1916 vintage with halved dielectric loss and 10 percent increase in amperes (E. F. Neuzel, Cincinnati). Recurrence of a 1941 epidemic of cable failures was averted in St. Louis by supplying water to 49 sections from 38 taps of water mains at a cost of $30 per section for metered use of an average 0.57 g.p.m., according to A. Bodicky. Milwaukee ducts were flooded every Wednesday whenever their temperature reached 44 or 45 C. and R. L. Dodd said a $5 to $10 outlay for water created a corrective which lasted a week.

At the joint session with the equipment committee M. C. Miller (Ebasco Services) presented a highly commended paper clarifying the merits of capacitors as generators of kilovar requirements and urging that kilovars supplant "power factor" in the language of the capacity-releasing engineer. Thousands of generator kilovars can be freed, he asserted, for kw. loadings by assigning the task to capacitors. A. N. Southgate (Public Service Electric & Gas) said his system has 134 megavars of capacitors, largely at substations, in addition to 193 of synchronous condensers, and the program is still to be completed. Miller had told of a case where a p.f. clause had prompted an industrial customer to put in 2,500 kvar of capacitors and, as a consequence, the utility had to put automatic control on its own 2,500 kvars to keep light-load voltage down. D. K. Blake (General Electric) likewise doubted the propriety of p.f. clauses under which industrial equipment salesmen dispose of capacitors for which utilities ultimately pay indirectly; they would do better to have the capacitors on their own systems under their own control. A. R. Malmstrom (Detroit) and R. T. Henry (Buffalo) said city network cables supply large kvars without capacitors. C. W. Mayott reported that all proposals for extensions were being scrutinized in Washington for opportunity to derive the advantages of capacitors; in one case they permitted a 26-kv. line to suffice, without regulating transformer, in lieu of a 66-kv. line.

Eight operating guides are being prepared under auspices of the A.I.E.E. standards committee, said R. T. Henry, in lieu of less effective modification of standards. M. S. Oldacre presented again the first one completed — the transformer guide—now an ASA standard. Others will be reported in January. H. W. Eales (Chicago) felt small companies would have to be more cautious in stretching ratings than large companies having laboratories. B. VanNess (Baltimore) made a renewed plea for a simple transformer-load temperature-indicator to assist the operator.

The Transportation Problem

Transportation is rapidly becoming a critical factor, said C. J. Hawk (Cincinnati), the ODT-21 about to be put in force making no provision for executive or supervisory car tires or fuel. Lighter weight units, fewer trips and sharply regulated mileage must ensue and public conveyances used. G. S. Van-Antwerp (Philadelphia) feared a breakdown in a storm emergency if allowances are to be based on normal maintenance and extension activities; his company has multiplied service centers to cut mileage.

Manufacturers reported through A. E. Silver and J. B. Hodtum that utilities are not adopting the new standard distribution transformers in keeping with the indications of the E.E.I. survey; too many still ask for taps. Information is being assembled toward a three-phase standard transformer. R. L. Dodd (Milwaukee) and T. J. Bronsan (Buffalo) reported conflict of tops and bosses with arms on joint poles.

Data on current capacities of various overhead conductors were presented by A. L. Malmstrom, H. A. Enos, L. R. Gaty and L. F. Hickernell. Pending correlation and extension by F. E. Sanford's committee, these data will be published shortly in ELECTRICAL WORLD as immediate information. Tests of three-strand guy wire as rural primaries (Malmstrom) showed discoloration at 75 amp., followed by rebrightening at 100 amp., annealing at 150 and flammation of the zinc with fusing of the iron at 200. It should not be used, he advised, where load currents are more than 100 amp. or fault currents above 1,000.

Many utilities reported taking down inactive wire (one order in one recent instance was to take down 60,000 ft.); other are changing to common neutral and use of neutrals as street-light returns to effect further releases, decrease tree conflicts, maintenance, etc. Incidentally, Rochester runs 7.5-amp. lamps at 2.7 by putting 480 volts on 2.4-kv. loops to provide red-glow markers in blackouts.

Cite Conservation Measures

Dozens of measures of conservation were cited at the round-table session, examples being: silphos and silver repair of switch contacts, reinforcement of cork gaskets by square iron wire inserts around holes, auto air-breaks astride line-tap services; rehabilitation of 4-amp. rectifier reconnected for 6.6 tub service; wooden boxes for housing-development outdoor meters; development of a regulator analyzer to tell when reconnection for doubled capacity is feasible; reworking of old crossarms to make midspan service takeoffs and even insulator-less secondary rack-spools; concrete anchors; Scott-connection to balance two furnaces on three-phase; overstock of 1½-kva. rural transformers tandemed for three-wire service; old poles shaved and pentachlorphenoled; post-type insulators horizontally to carry 26-kv. on a 6-ft. pipe-line right-of-way; hot-shot dry cells for tripping duty.

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Energy Requirements Up

Electric energy requirements of the principal public utility systems of the country during August, 1942, totaled 15,808,230,000 kw.-hr., a gain of 12.2 percent over the same month last year, according to an announcement by the Federal Power Commission. Corresponding peak demands aggregated 30,045,823 kw., an increase of 8.0 percent over August a year ago. Utility estimates of peak demands for December, 1942, are reported to amount to 35,870,010 kw., a decrease of 103,000 kw. from a similar forecast submitted by the utilities in their July report.

H. A. Lott, Southern California Edison, Los Angeles, and L. J. Moore, Pacific Gas & Electric, Fresno, head the PCEA operating economics section. N. B. Hinson, Southern California Edison executive engineer, and I. W. Collins, Pacific Gas & Electric chief load dispatcher. A. E. Strong, Coast Counties Gas & Electric general superintendent, and F. R. George, Pacific Gas & Electric manager of operations

Utilities' Wartime Problems Occupy P.C.E.A. Meeting

Fall war conclave brings out vigorous discussion on interconnections, emergency maintenance techniques, materials salvage, manpower shortages, dimouts and public relations

Wartime complexities ranging from obtaining and training replacement personnel, restrictions and regulations brought on by dimouts, emergency maintenance techniques occasioned by material shortages and substitutions and customer and public relations difficulties due to gasoline and tire rationing, through the gamut to planning for the future, featured the fall war conclave of the Pacific Coast Electrical Association at Fresno, Calif., recently. President S. E. Gates, General Electric Los Angeles manager, told the 254 in attendance that the electrical industry's prime responsibility was to contribute everything it could from electric power to manpower to winning the war.

Systems Meet Peak Demands

Integrated system operations through interconnections in both northern and southern California are providing power to meet all war demands from the cheapest generating sources irrespective of ownership. Northern California systems met a peak demand for 1,350,000 kw. recently and have adequate resources in sight to care for a 1943 anticipated load of 1,600,000 kw. Cooperative action sponsored by the southern California Power Interchange Committee recently gave the southwest area the output of an 87,500-kw. Boulder unit throught an interchange agreement involving the USBR, the Defense Plant Corporation, the Metropolitan Water District, the Los Angeles Bureau of Power and Light and the Southern California Edison Company. In order to hook an available MWD generating unit to the southwest transmission network, it was necessary for the Los Angeles Bureau to loan Boulder unit A-2 to Edison. A-2 was hooked to the completed A-5 transformer installation through 1,000 ft. of 1,000,000 cir. mil cable salvaged from assorted lengths of smaller cables and spliced with silver solder at 15 places. Normal operation will be restored when unit A-5, now under construction, is completed.

Many noteworthy salvage and substitute material techniques were brought out. Short lengths of underground cable are being stripped, unstranded welded together and in some instances redrawn to produce supplies of No. 8 conductor. No. 4/0 copper is being redrawn to No. 2/0. Old oval trolley wire is being annealed and used as ground wire. Duplicate lines put in to insure service continuity to pre-war industrial plants or commercial areas are being withdrawn from that service and put to work serving war industries.

Maintenance operations described the use of bronze insert stationary runner seal rings for hydro units with a caulking of soft copper. This latter was obtained by burning insulation from scrap conductor in a wood fire to anneal the metal. Repairs were made to a worn water wheel runner shaft by machining the worn places and welding in stainless steel rings which were later ground to a mirror finish. Rawhide packing is being used in waterwheel bearings. Various ingenious devices ranging from a ball-shaped bundle of oak branches to a wheel-mounted set of brooms are being employed to remove algae from hydro conduits in place of blue stone, which is on the critical list. Steam plant maintenance kinks included the use of steel in place of monel metal for gaskets on boiler handholes and non-metallic enamel coatings on equipment subject to corrosion.

Fred Wellhouse, Westinghouse lighting expert and I.E.S. Western vice-president; P. P. Pine, San Diego Gas & Electric commercial manager, and Frank C. Angle, Allis-Chalmers San Francisco manager. V. F. Estcourt, Pacific Gas & Electric steam plant engineer; Alf Hansen, General Electric turbine specialist, and F. G. Philo, Southern California Edison, manager of steam generation

Manpower shortages are reflected in higher accident rates and shorter training periods. The War Manpower Commission training within industry program was considered as a promising method for indoctrinating new employees. It is being employed successfully by Utah Power & Light and Idaho Power. Extensive newspaper advertising is being used to recruit new employees. Women are being employed more extensively and previous tacitly maintained racial barriers are being waived.

The industrial discussion group explored the possible future absorption of new wartime electric capacity, predicted that the heavy machine tools, the new steel mills, the many light metal plants built for the war in the West would place the region on a competitive basis with the East after the war in shipbuilding, aircraft freighters, industrial production of all types. The necessity of keeping the dealer service organization to maintain appliances was urged by Clark Chamberlain, Bureau of Radio and Electrical Appliances, San Diego, lest the entire service burden descend upon utilities.

R. E. Fisher, vice-president Pacific Gas & Electric, launched the P.C.E.A's planning committee, its eyes trained on the future direction of the industry. Its work will coordinate the planning of other regional and national organizations, seek to steer the electrical industry back into channels of business management and enterprise after war's regimentation is discharged.

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Field Offices to Take WPB Appeals

Appeals by manufacturers for relief from the restrictions imposed in 31 WPB limitation and conservation orders now may be filed only in WPB field offices on Form PD-50, under terms of Priorities Regulation 16. Heretofore, appeals from these orders were filed in Washington.

Orders covered by the regulation include those halting or limiting production of refrigerators, laundry equipment, vacuum cleaners, phonographs, metal signs, portable electric lamps, fluorescent lighting fixtures, electric heating pads, electric fuses and iron and steel.

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N. J. Darling Dies

Nelson J. Darling, manager of General Electric Co.'s West Lynn and River Works, died on October 26 at his Beach Bluffs (Mass.) home, after an illness of a few months. He was 58 years old.

Utility Labor Unions Organize National Group

Membership of 251,000, comprising 24 independent utility labor unions, claimed at Chicago meeting of United Utilities Union of America — Telephone workers may be affiliated

The organization of independent labor unions in the utility industry into a group known as the United Utilities Union of America got off to a fast start in Chicago last week when 24 unions from many of the big-name utilities signed up, bringing in a membership of 251,000. Formation of the new group is in line with a movement to tie independent unions together into a federation big and strong enough to carry weight in Washington.

No AFL-CIO Tie

It is pointed out by officials of the new U.U.U.A. group that they have no quarrel with the A.F.L. or C.I.O. but the feeling is that the one-system, utility bargaining organization seems better fitted to their needs than a utility independent union split up into A.F.L. craft locals or tied together into vertical organizations of the C.I.O. Unexpressed, but nevertheless present, is the conviction that the utility workers' feeling of public responsibility averages higher than the membership of the older federations.

Distaste for bigger organization's policies is evident in the newly adopted U.U.U.A. constitution, which prevents self-perpetuation of officers and provides easy means for a referendum of membership that can commit the body to anything except waiver of a national convention.

President of the U.U.U.A. is Joseph A. Fisher, Brotherhood of Consolidated Edison Employees. Secretary-treasurer is Herbert Sanford, United Brotherhood of Edison Workers. Permanent headquarters will be decided upon next month at a Pittsburgh meeting of the executive committee.

Practically all of the 24 unions now constituting the U.U.U.A. have been through representation contests with the A.F.L. or C.I.O. and have been certified by the National Labor Relations Board or a state labor board, and have battled their employers to major decisions. The committee turned down several applicant unions as too new or too closely connected with management. Doubters, however, raise the point that some of the independents accepted have in the recent past been suspected of being company fostered.

It may be expected that the new U.U.U.A. may make an effort to bring the National Federation of Telephone Workers, with its 150,000 members, into the fold. The telephone group appears to be shopping around before making up its mind. An official of the telephone group was present at the Chicago organizing session of the new utility group and qualifications for membership were framed to include telephone men.

Independent unions representing employees in the following companies are now signed up: Boston Edison, Central New York Power, Cincinnati Gas & Electric, Cleveland Electric Illumination, Commonwealth Edison, Consolidated Edison, Duquesne Light, East Ohio Gas, Florida Power & Light, Gulf States Utilities, Indiana General Service, Indiana-Michigan Electric, Indianapolis Power & Light, Kansas City Power & Light, Long Island Lighting, Louisville Gas & Electric, Nebraska Power, Ohio Power, Queensborough Gas & Electric, Southern Indiana Gas & Electric, Twin Cities Gas & Electric, Union Electric System, United Illuminating and Virginia Electric & Power.

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OPA to Define Rate Increases

Price Administrator Leon Henderson will define general rate increases in a regulation outlining the character of notice and information which public utilities must furnish his agency before boosting charges under terms of the anti-inflation law (ELECTRICAL WORLD, October 10, 1942, page 3).

It was understood in Washington that a general rate increase will be defined to cover any price boost in a filed schedule under which a class of consumers may purchase power or light service. The definition is not expected to include individual industrial contracts.

Henderson warned that his agency must be notified of proposed rate increases decided upon before the forthcoming, detailed regulations are made public, and added that utilities must present such notification before the regulatory body approving such boost closes the case. Notices are to be filed with OPA's Transportation and Utilities Division, Washington.

Outline Plan for Middle West Corp.

A recommendation that the single integrated system of Middle West Corp. be the main electric system of Public Service Co. of Oklahoma, together with some additional facilities, was made by counsel for the staff of the public utilities division of the SEC, during final oral argument before the commission last week, in the "death sentence" proceedings against the holding company. As an additional integrated system, it was suggested that the electric system of Southwestern Light & Power Co. might be retained by Middle West, under Section 11 (a) and (c) of the Holding Company Act. However, Wilbur A. Osterling, SEC counsel, said that the company should be given opportunity, should it so desire, to present evidence on the appropriateness of the commission's choice. Other companies they might prefer, he said, include Southwestern Gas & Electric, West Texas Utilities, Central Power & Light, Kentucky Utilities (eastern), Central Illinois Public Service or Wisconsin Power & Light.

During the oral argument Eugene P. Locke, counsel for Middle West Corp., proposed a new method of computing the measurement of square mileage in the service area of a holding company. He proposed the new "yardstick" in asking commission approval of a plan for the establishment of Central & Southwest Utilities Co. as a top holding company, with five operating subsidiaries, serving an area 1,220 miles in length. In addition, he argued that the holding company should be permitted to retain both the Central Illinois Public Service Co. and the Kentucky Utilities Co. as a single integrated system within the meaning of the "death sentence" clause. It was Middle West's intention, Mr. Locke said, to divest itself of all interest in Central and Southwest following its recapitalization.

Commenting on the proposed single integrated system of Central and Southwest, SEC counsel asserted that the area which would be served by the companies five subsidiaries comprised 175,000 square miles. Refuting this conception, Mr. Locke claimed that because of the thousands of square miles of the territory which was wholly unpopulated or, at best, thinly populated, the area served should be based on a computation of the square mileage of the cities and towns served. Using this "yardstick," Mr. Locke asserted that the total square miles served was actually 3,684, rather than 175,000. Referring again to the length of the system, he quoted Robert E. Healy, SEC commissioner, who testified that the American Gas & Electric Co., extending 1,400 miles from the Great Lakes to Tennessee, was a "geographically and economically integrated public utility system."

The oral arguments wound up "death sentence" proceedings against Middle West Corp., first instituted in March, 1940. Opposing counsel were given ten days to file reply briefs, after which the commission will announce its decision.

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E.B. & S. Units File Court Appeal

American Power & Light Co. and Electric Power & Light Co., two major sub-holding units in the Electric Bond & Share Co. system, filed briefs in the First Circuit Court of Appeals recently, petitioning for a review of Securities and Exchange Commission orders requiring dissolution of the companies under Section 11(b)(2), the corporate simplification clause, of the Holding Act. The recent action, initiated by American, was a direct reversal of the position the companies took following issuance of the SEC order on August 22. At that time company stockholders were advised that it was not advisable to seek court review of the dissolution order.

While any legal rights of the company and its stockholders are thus being preserved, Howard L. Aller, president of American, informed stockholders, the directors and officers "are actively engaged in the formulation of plans for such reorganization steps under the Public Utility Holding Company Act as may be practicable under present conditions and permitted by the Securities and Exchange Commission." The decision to appeal, incidentally, came after the recent stormy Bond & Share stockholders' meeting in which individual holders demanded that the management take steps to protect stockholders' interests where SEC dissolution orders were concerned.

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San Antonio Utility Sold

Purchase of the properties of the San Antonio Public Service Co. by the city of San Antonio was announced October 24 by Mayor C. K. Quin. Bonds for the purchase of the utility, totaling $33,950,000, which were subscribed to through sealed bids opened August 24, were delivered to A. C. Allyn & Co. of New York, the investment banking house handling the transaction. The company is a subsidiary of American Light & Traction Co. and sale of the property was made necessary by the integration provisions of the Holding Company Act.

The Guadaloupe-Blanco River Authority, prior to the present transaction, had evidenced a desire to purchase the San Antonio utility and had obtained a temporary injunction against steps taken by the city for the acquisition of the properties.

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Detroit to Ask Utility for $8,000,000 Refund

Detroit Common Council will be asked to approve immediate filing of a rate case against the Detroit Edison Co., seeking a refund of $8,000,000 to consumers, Paul E. Krause, Corporation Counsel, has announced.

The movement to start suit against the utility followed a conference between Mayor Edward J. Jeffries and Alfred C. Marshall, president of the utility. Mr. Marshall rejected the Mayor's request that the company make an $8,000,000 rebate rather than pay the money out in excess profits taxes. He said the proposal, which according to city officials had received the sanction of the U. S. Treasury Department, had been turned down at a recent meeting of the board of directors.

MEETINGS

Pennsylvania Electric Association—Systems Operation Committee, Hotel Harrisburger, Harrisburg, Pa., November 5; Transmission and Distribution Committee, Harrisburg, Pa., November 13. A. B. Millar, managing director, State Street Bldg., Harrisburg, Pa.

Previously Listed

Canadian Electrical Association—Conference of all committees, Windsor Hotel, Montreal, Que., November 2-3. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal, Que.

National Association of Railroad and Utilities Commissioners—Annual convention, St. Louis Mo., November 10-12. Ben Smart, secretary, 7411-13 New Post Office Bldg., Washington, D. C.

American Society of Mechanical Engineers—Annual meeting, Astor Hotel, New York, N. Y., November 30-December 4. Ernest Hartford, executive assistant secretary, 29 West 39th St., New York, N. Y.

National Exposition of Power and Mechanical Engineering—Madison Square Garden, New York, N. Y., November 30-December 4.

National Association of Manufacturers—Congress of American Industry, Waldorf-Astoria Hotel New York, N. Y., November 30-December 4. G. G. Geddis, 14 West 49th St., New York, N. Y.

American Society of Agricultural Engineers—Fall meeting, LaSalle Hotel, Chicago, Ill., December 7-9. Raymond Olney, secretary, St. Joseph, Mich.

American Society of Civil Engineers—Annual meeting, headquarters, New York, N. Y., January 20-22. George T. Seabury, secretary, 33 West 39th St., New York, N. Y.

American Institute of Electrical Engineers—Winter convention, New York, N. Y., January 25-29. H. H. Henline, secretary, 33 West 39th St., New York, N. Y.

Output Resumes Seasonal Rise

The power output curve, which remained at about the same level for the past two weeks, resumed its normal seasonal rise with the publication of the figures for the week ended Oct. 24. For that week the amount of electrical energy distributed by the electric light and power industry amounted to 3,752,571,000 kw.-hr., as compared with 3,717,360,000 kw.-hr. for the week ended Oct. 17. The percentage increase from the corresponding week of 1941 was 12.3 percent—approximately the same as the 12.2 percent increase registered in the previous week.

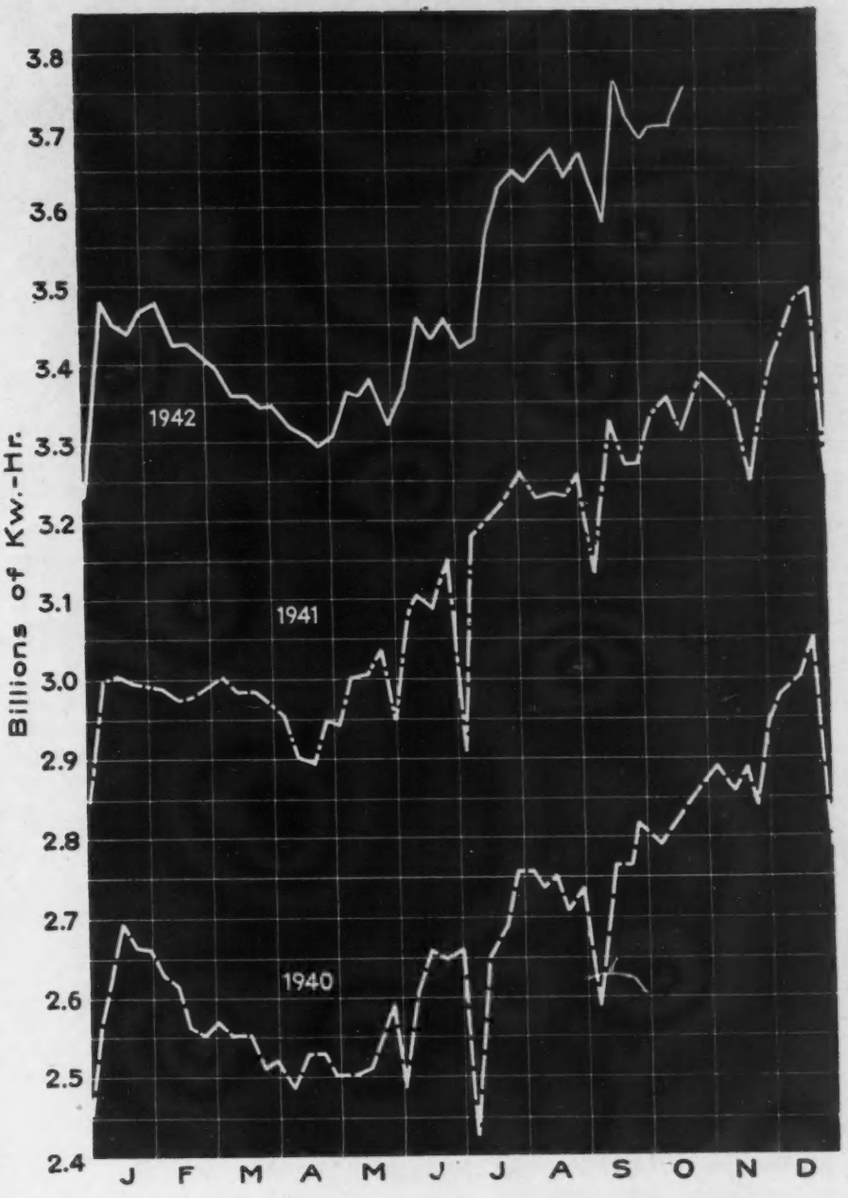
The Pacific Coast region continued to lead the rest of the country in percentage increases over last year's figures, jumping from 28.1 percent for the Oct. 17 week to 30.7 percent for the latest week. Biggest gain for the latest week over the previous, compared to last year, was registered in the Rocky Mountain states—from 8.9 percent gain to 13.1 percent.

Weekly Output, Millions Kw.-Hr.

1942		1941		1940	
Oct. 24	3,752	Oct. 25	3,341	Oct. 26	2,867
Oct. 17	3,717	Oct. 18	3,313	Oct. 19	2,838
Oct. 10	3,702	Oct. 11	3,355	Oct. 12	2,817
Oct. 3	3,683	Oct. 4	3,330	Oct. 5	2,792
Sept. 26	3,720	Sept. 27	3,273	Sept. 28	2,816
Sept. 19	3,757	Sept. 20	3,273	Sept. 21	2,769
Sept. 12	3,571	Sept. 13	3,322	Sept. 14	2,773
Aug. 29	3,640	Aug. 30	3,261	Aug. 31	2,736
Aug. 22	3,674	Aug. 23	3,231	Aug. 24	2,714
Aug. 15	3,655	Aug. 16	3,238	Aug. 17	2,746

Percent Change from Previous Year

	Week Ending		
	Oct. 24	Oct. 17	Oct. 10
New England	+ 4.1	+ 5.5	+ 1.0
Mid-Atlantic	+ 5.6	+ 6.2	+ 2.1
Central Industrial	+ 7.9	+ 8.2	+ 6.2
West Central	+10.6	+10.9	+10.8
Southern States	+17.6	+17.6	+16.6
Rocky Mountain	+13.1	+ 8.9	+ 8.4
Pacific Coast	+30.7	+28.1	+30.8
Total United States...	+12.3	+12.2	+10.3



Energy Sales Advance 12.9% in August

Sales of electric energy to ultimate consumers in August totaled 13,650,227,000 kw.-hr., compared with 12,087,158,000 kw.-hr. in August, 1941, an increase of 12.9 percent, according to the report issued by the Edison Electric Institute.

After dropping in July to only a 16.9 percent gain over July, 1941, generation by water power plants in August again jumped to a 35.3 percent increase over August, 1941.

Revenue from ultimate customers amounted to $238,059,100, compared with $223,514,900 in August, 1941, an increase of 6.5 percent.

Average annual use for the twelve months ended August 31 advanced to 1,013 kw.-hr. per customer from 974 kw.-hr. for the twelve months ended August 31, 1941. The average annual bill rose 1.8 percent, from $36.72 to $37.38 for the twelve months ended August 31, 1942. Revenue per kilowatt-hour dropped to 3.69 cents from 3.77 cents for the twelve months ended August 31, 1941.

Classification of Sales, August, 1942, and Change from 1941

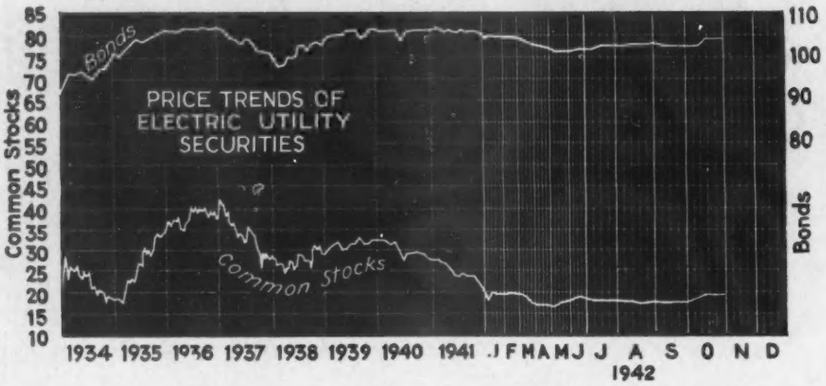
Kilowatt-hour sales— During month of August	Million Kw.-Hr. 1942	1941	% Change
Residential or domestic...	2,104	1,969	+6.8
Rural (Distinct rural rates)	386	329	+17.3
Commercial or industrial			
Small light & power.....	2,328	2,131	+4.2
Large light & power.....	7,727	6,730	+16.5
Street & highway lighting..	151	154	—2.2
Other public authorities..	365	259	+41.1
Railways and railroads			
Street & interurban.....	328	300	+9.1
Electrified steam.....	195	173	+12.4
Interdepartmental	66	40	+66.7
Total to ult. customers..	13,650	12,087	+12.9

FPC Approves Wisconsin Plan

The Federal Power Commission last week announced its order approving a plan submitted by the Wisconsin Michigan Power Co., Appleton, Wis., for adjusting the company's electric plant account by the elimination of $2,226,822.

The reduction will be accomplished by applying $905,907 against a credit of that amount in the "electric plant acquisition adjustment" account, by charging $7,921 to the "other physical properties" account, by charging amounts aggregating $401,993 to "reserve for depreciation," by charging a total of $561,151 to capital surplus and by including in the "electric plant acquisition adjustment" account the amount of $349,847, to be amortized at the rate of $24,000 annually.

Utility Stocks Advance; Bonds Hold Firm


PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
Bonds
Common Stocks
Common Stocks
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
Bonds
1934 1935 1936 1937 1938 1939 1940 1941 J F M A M J J A S O N D
1942

Electric light and power stocks continued their upward trend during the past week, carrying the "Electrical World" index to 19.7 from 19.5 the previous week; last year, 22.1. Bonds remained at 103.5; last year, 105.7

FINANCIAL BRIEFS

THE SEC HAS POSTPONED until November 9, hearing originally scheduled for October 20 on the application of Associated Electric Co. and Tri-City Utilities Co. with respect to the reduction by the latter of its capital stock from time to time, through the purchase and retirement of its common stock at par value, to the extent of such funds as become available to Tri-City through the sale of properties. Sale of Tri-City to Kentucky Utilities was announced recently (ELECTRICAL WORLD, October 24, page 8).

CENTRAL NEW YORK POWER CORP. has received approval of the Public Service Commission for a $741,560 reduction of capital stock by retirement of 7,416 outstanding 5 percent preferred shares.

THE SEC HAS PERMITTED the amended declarations of Eastern Shore Public Service Co. (Del.) and Eastern Shore Public Service Co. (Md.) to become effective. The declarations dealt with the proposed redemption by Maryland of its outstanding bonds by $200,000 at par and accrued interest in accordance with the terms of the indenture securing them. All of Maryland's $3,892,500 principal amount of these first mortgage 4 percent bonds, due 1969, are owned by Delaware which will apply the $200,000 to reduction of an unpaid balance of $800,000 owed New York's Chase National Bank.

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Utility Financing Drops 50 Percent

New issues of electric light and power securities during the first nine months of 1942 amounted to $300,929,490, compared with $610,788,800 for the similar period of 1941, a decrease of 50.7 percent.

In September new light and power financing amounted to $39,140,000, compared with $4,418,000 in August and $16,498,700 in September, 1941. Southwestern Public Service Co. issues—three in number—accounted for $32,925,000 of the month's total.

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Associated Applies to Buy Own Bonds

Associated Electric Co., sub-holding unit of Associated Gas & Electric Co., has filed application with the Securities and Exchange Commission to approve proposals for reducing its funded debt and thereby cut interest requirements.

Under the plan filed Associated Electric proposes to acquire $3,602,000 principal amount of its own 4½ percent bonds, due 1956, from Metropolitan Edison Co., for a cash consideration of $1,548,860 plus accrued interest, and to acquire another $2,222,000 of its own 4½ percent bonds, due 1953, from the Staten Island Edison Corp., for $955,460 cash plus accrued interest.

Metropolitan Edison and Staten Island Edison also asked consummation of the plan in order that they might dispose of their cross-holdings of securities in the same holding company system, and that the cash proceeds will be used partially to retire their own presently outstanding indebtedness.

Utility Reports

	Net Income 1942	1941
*California-Oregon Power...	$1,028,294	$912,908
†Central Hudson Gas & Elec.	1,488,981	1,511,737
†Central Maine Power.....	1,880,540	2,103,553
†Detroit Edison and subs...	8,998,263	12,329,340
*Duquesne Light	10,043,782	9,874,600
†Marion Reserve Power.....	505,519	562,572
*Mountain States Power.....	637,379	697,806
†Northern Indiana Pub. Serv.	2,059,619	2,911,112
*Northwestern Electric	579,736	502,925
*Philadelphia Company and subs.	6,487,412	6,310,538
†Public Service New Hampshire	1,373,396	1,342,711
†Public Service New Jersey.	17,767,349	20,073,309
*San Diego Gas & Electric.	1,625,862	1,831,352
†Tampa Electric	1,256,229	1,509,731

*Twelve months ended August 31.
†Twelve months ended September 30.

New Issues of Electric Light and Power Securities in September

Name of Company	Amount (Par Value)	Offered to	Period (Years)	Class	Purpose	Interest Rate	Price	Per Cent Yield
Consumers Public Service Co...	$225,000	Placed privately.	.....	Bonds.....	Refunding, retire bank notes	4½	.....	.....
Edison Sault Electric Co.....	990,000	Placed privately.	30	1st mtge. bonds.....	Refunding, reduce bank loans, corporate purposes	3¾	104	3.53
Potomac Electric Power Co....	5,000,000	Public.....	35	1st mtge. bonds.....	Working capital.....	3¼	113	2.67
Southwestern Public Service Co.	20,000,000	Public.....	30	1st mtge. and collateral trust bonds	Refunding.....	4	107½	3.59
	6,000,000	Public.....	1–12	Serial notes.....	Refunding.....	2¼–3	Average of 100.16%	.....
	6,000,000	Public.....	.....	Cumulative preferred stock	Purchase of securities of constituent companies	6½	100	6.50
	925,000	Public and stockholders of constituent companies	.....	Common stock.....	Purchase of securities of constituent companies	.....	5	.....
	$39,140,000							

HOW DESIGN . . . CONSTRUCT OPERATE MAINTAIN

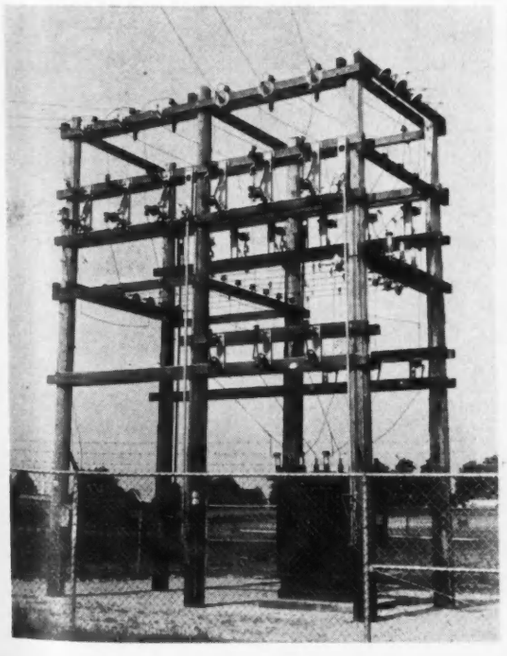
2-Way Power Supply, 1-Way for Regulation

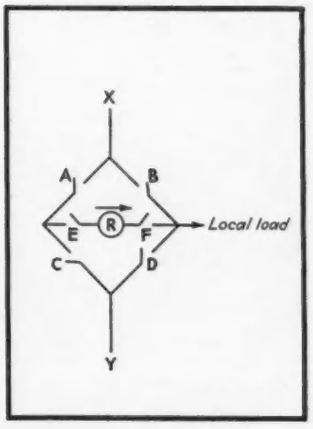
An interesting switching arrangement in a substation of wood construction is the method used to feed power through the station from either of two directions, and yet carry the power through the regulator in one direction only.

The substation is shown in an accompanying illustration and the double-Z (square and diagonal) switching connections are outlined in the single-line diagram.

At times it is desired to feed power through the station from X to Y, and at other times, from Y to X. The arrow shows direction of current through regulator (R) at all times.

Method of switching is as follows: When current is fed from X to Y, switches A and D are closed and C and B are opened. When current is fed from Y to X switches A and D are opened and C and B are closed. Switches A, B, C and D are R & I E type DR, two-insulator center-break, horizontal-opening type disconnects. Switches E and F are used to disconnect the regulator.





SINGLE-LINE DIAGRAM of switching arrangement

←

AT THIS substation power may be fed through in either of two directions, but in one direction only through the regulator

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Transformer Polarity for Instruments

By PAUL MacGAHAN

Meter Division Westinghouse Electric & Manufacturing Company, Newark, N. J.

Instruments, meters or relays which have both current and potential coils depend upon the application of the correct relative polarities. To date no standardization has been agreed upon for the polarity and positions of a.c. instrument terminals. Inasmuch as different makes or types may vary in this respect, the wiring diagrams furnished with the instruments must be followed in each case. When instrument transformers are employed it is necessary to take account of the instantaneous polarities of their terminals.

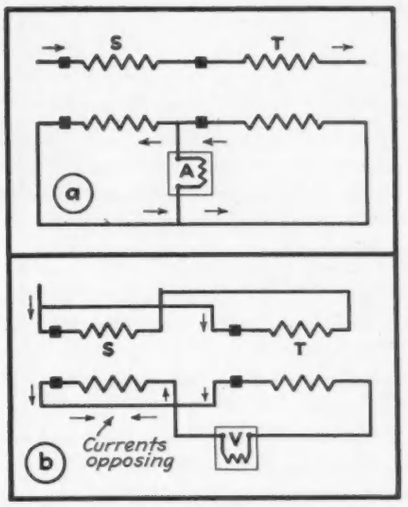


Fig. 1—Polarity of instrument transformers (T) checked by comparison with a standard transformer (S) of the same ratio. (a) Current transformers—with polarities as indicated, current in ammeter (A) will be zero. (b) Potential transformers—with polarities as indicated, reading of voltmeter (V) will be zero.

The instantaneous polarity of the primary and secondary lead terminals of instrument transformers are marked by the manufacturer with distinctive "polarity markers." These may consist of any convenient means which cannot be readily obliterated (A.S.A. Standard C-57, rule 4-070).

If the polarity markings of a transformer have been obliterated, or if for other reasons it is desirable to make a test of the polarity, one of the following methods may be employed:

1. A simple method is to check the marking against a standard transformer, connecting first one transformer and then the other into the same circuit and to a wattmeter. If the wattmeter reading is positive in each case, the relative polarity will be the same.

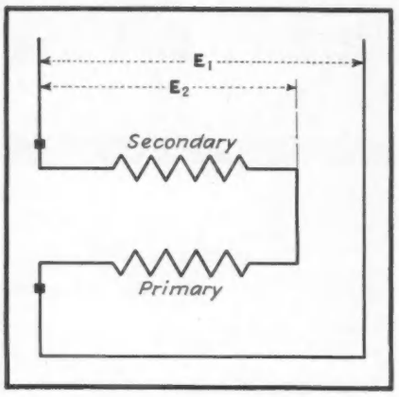


FIG. 2—Primary and secondary of instrument transformer connected in series. Polarity is as indicated if voltage E_1 is less than E_2

2. Another method of checking with a standard transformer is indicated in Fig. 1 (a) or (b).

In the test indicated for current transformers in (a), a 10-amp. ammeter (A) would be satisfactory if the test is made with a current of a value from one-half to full load passed through the primary windings. In the case of heavy current transformers it may be more convenient to use a smaller primary current, as, for example, from 1/10 to 1/5 of the primary rating, in which case the use of a 2-amp. ammeter (A) is desirable. In other words, select an ammeter which corresponds to approximately double the secondary current which can circulate during the test. A zero reading in the ammeter indicates correct polarity and a violent throw of the pointer toward full scale indicates opposite polarity because the current in the ammeter is the sum of the secondary amperes.

In the test indicated in (b), which is for potential transformers, the voltmeter (V) selected should preferably be suitable for approximately double the expected secondary voltage. With correct polarity the secondary voltages will "buck" and the voltmeter will read zero. But if the polarity is reversed there will be double voltage on the voltmeter.

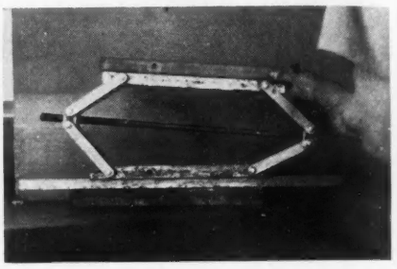
If normal primary voltage is applied the voltmeter may be of 300-volt range. If it is more convenient to apply a lower voltage to the primary windings a suitably lower range voltmeter may be substituted.

These tests may also be made with standard transformers which have a somewhat different ratio from those of the transformer tested, by selecting ammeters or voltmeters of suitable range. This is done by making two readings with reversed polarity connections. The correct polarity connection will show the lower of the two instrument readings.

3. A third method which does not require a standard transformer is indicated in Fig. 2. The applied voltage E_1 should be about 5 volts for a current transformer and any convenient value for a voltage transformer, corresponding to the voltage applied at E_1. The disadvantage of this method is that E_1 may be so nearly equal to E_2, if the transformer ratio is very high, that it will be difficult to read the difference.

Pantograph Jack for Regulator Coils

How do you get the coils into position down inside of a regulator stator? Shop men of the Portland General Electric Company, Portland, Ore., do it by means of a cleverly designed jack they made, on the pantograph principle. The threaded rod which actuates the arms of the pantograph as seen in the illustration extends to the right and there is a long, detachable crank handle which turns it, similar to the long crank which operates an automobile jack.

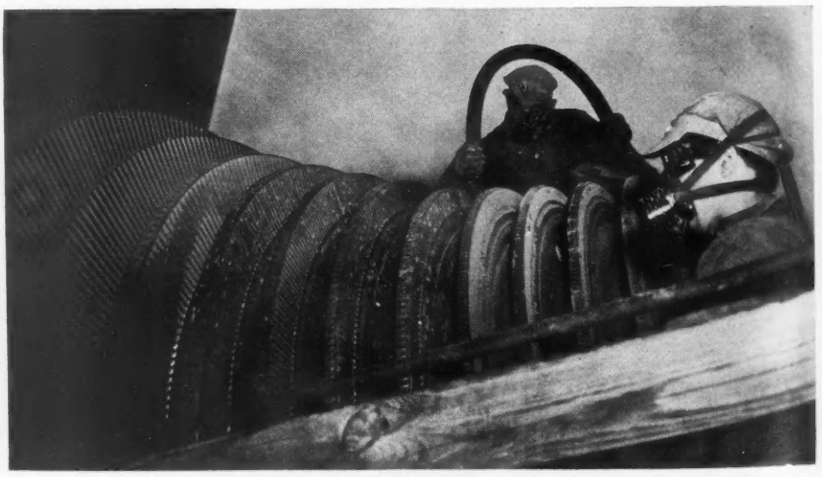


TOGGLE MECHANISM for reinstalling coils in induction regulator stator

They simply slip this jack down in-

[*Continued on page* 92]

Fly Ash Used in Cleaning Rotors



A most effective method of removing insoluble deposits such as silica from steam turbine rotors is being emphasized by the General Electric Co. as a contribution to the important work of keeping generating equipment of all ages up to service requirements under the stress of war. Fly ash is fed into a jet of compressed air in amounts similar to the quantity of sand employed in sand blasting. Soluble deposits can usually be removed during overhaul by subjecting nozzles and buckets to a strong jet of water and compressed air. Some soluble deposits can be removed by various washing methods without disassembling the turbine.

The *Easy* and *Fast Way* to Make Load Surveys

Hook-on recorder (Type CF-1) gives permanent records

Hook-on volt-ammeter (Type AK-1) makes quick checks

THE INDICATOR

For checking load conditions in residential areas or on industrial feeders, the AK-1 is just the "ticket." Forget about cutting conductors or interrupting service. Just hook the instrument around the conductor, flick the selector switch to AMPERES and you have your measurement. Linemen like its one-hand operation and light weight.

Measures Both Volts and Amps

It measures voltage, also. Just connect the voltage leads, snap the switch to VOLTS, and take the reading (leave it hooked around the conductor or not, as you please). You need no extra equipment.

It's really six instruments in one—because there are six ranges—0–15/60/150/600 amp and 0–150/600 volts (for a-c circuits only). Accuracy, ±3 per cent. Extension poles, in four- and six-foot lengths, are available for use on high-voltage circuits, and for reaching into inaccessible places.

THE RECORDER

For *records* of the duration of peak loads and the time at which they occur, you'll find this G-E hook-on recorder (Type CF-1) the handiest one you've ever used. It's INKLESS—ready to go at a moment's notice—no pen to start, no inkwell to fill. Like the AK-1, it can be used without cutting conductors or interrupting service. Just hook the split-core current transformer around the conductor, connect the Telechron motor leads to a 115- or 230-volt circuit, and it starts to record.
Accuracy, ± 4 per cent.

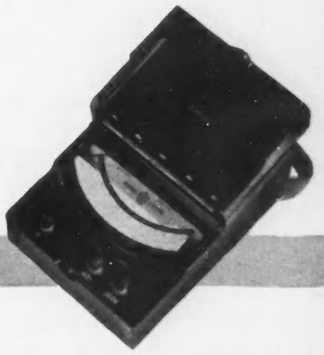
New Low Chart Speed

You can now get a 30-day record on a 30-inch chart—with our new one-inch-per-day chart speed. You'll find that analyzing survey records is greatly simplified by the shorter chart length. The former speeds of 1, 2, and 3 inches per hour can still be obtained.

Where and How to Use Them

Further information about these instruments is given in Bulletins GEA-2950 (volt-ammeter) and GEA-3187 (recorders). Your G-E office has copies, or write to General Electric, Schenectady, N. Y.

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment



ANOTHER HANDY INSTRUMENT

This Type AP-9 medium-size, portable instrument should be in every testing set. It is only 4¾ by 6½ by 2½ inches. You'll want this instrument for those jobs requiring a higher degree of accuracy—it's accurate to within ¾ of one per cent of full-scale value. Both voltmeters and ammeters can be obtained. Ask for Bulletin GEA-1784.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

602-38-6200

side the stator to any point desired and push the coil over by turning the handle and forcing the faces of the pantograph apart. It is simple and saves impatient language, just as did the long-handled car jack, which enables one to set the jack any place desired without assuming a prone position under the car.

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Maintenance of Insulating Oil

I. Nature, Specifications *

By L. M. LIMPUS
Superintendent of Reclamation
Oklahoma Gas & Electric Company

Insulating oils, aptly termed the "life-blood" of the electric industry, have suddenly risen to a degree of tremendous importance in our war effort, for they, and they alone, can adequately protect the older units of oil-filled apparatus which are now likely to be grossly abused by overloads and high temperatures far in excess of those originally intended and anticipated by the manufacturing designer. Very few, indeed, are the pieces of oil-filled apparatus which will withstand the maltreatments of the immediate future unless the insulating oil is maintained at a quality commensurate with good maintenance practice.

Modern insulating oils contain some 2,000 different compounds of paraffin, naphthene and aromatic hydrocarbons, with perhaps some traces of residual petroleum resins and sulphur compounds. Exacting specification requirements have been set for dielectric strength; high flash, high fire and low freeze points; freedom from mineral acids, free sulphur, alkalis and sulphates; stability, durability and resistance to oxidation. These latter characteristics of stability, durability and resistance to oxidation vary appreciably with the type of the original crude, the location or formation from which it was obtained, and the degree and manner of its refinement. For these reasons the operator should exercise extreme caution in the purchase of "make-up" oil and the promiscuous mixing of service oil.

Standard specification for mineral insulating oil, as generally recognized throughout the industry, follows:

1. Dielectric strength—22 kv. minimum.
2. Flash point—130 deg. C. minimum.
3. Fire point—150 deg. C. minimum.
4. Pour point—minus 40 deg. maximum.
5. Viscosity—60 seconds, Saybolt at 37 deg. C. maximum.
6. Neutralization number—less than 0.05 Mg KOH.
7. Freedom from mineral acids, chlorides and sulphates.
8. Freedom from free sulphur or corrosive sulphur compounds.
9. Steam emulsion number—less than 25 seconds.
10. Freedom from visible sludge after twelve days in accordance with the Synder life test method.

Highly Complex Substance

Operating engineers and maintenance supervisors should realize that insulating oil is a highly complex substance, and necessarily so because of the peculiar functions of insulation and cooling which it must perform. The apparatus to which it is assigned was designed with the oil as a fundamental part of the insulation, and the designer anticipated that it would be maintained in its approximate original state. It is subject to rapid deterioration if improperly handled, or neglected, and may in itself prove a definite hazard to the operation of electrical oil-filled apparatus. This oil must be kept relatively free from contamination by moisture, fibers, dust, acids, corrosion, carbon and sludge, and it is well to remember that each contaminant is satisfactorily removed or controlled only by the proper methods peculiar unto itself. The deterioration assault is gradual to a degree of subtleness, demanding vigilance and understanding if adequate control over apparatus failure is to be accomplished.

*First in a series of ten installments.

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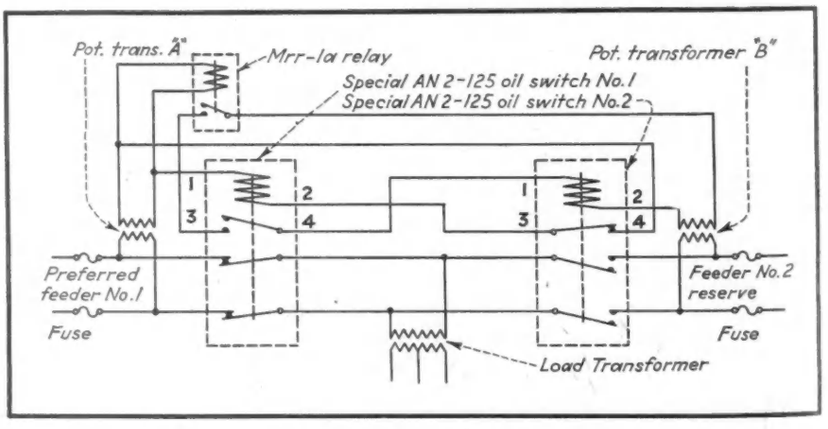
Throw-over for Protective Lighting

A simple but effective relay scheme for the automatic switching of moderate loads between preferred and reserve feeders has been developed and applied by the South Bend Current Controller Company, South Bend, Ind. The switching scheme has been applied to protective lighting and similar systems where continuity of supply is essential, but it is applicable to many other moderate duty throw-over problems.

The relay circuit, as shown, is in its normal operating condition. The load transformer is energized from the preferred feeder (No. 1), with the reserve feeder (No. 2) energized but not carrying load.

Upon failure, for any reason, of the preferred circuit (No. 1) potential transformer "A" is de-energized and with it the coils of the MRR-LA relay and the No. 1 oil switch. As the load contacts of the No. 1 oil switch drop open the relay contacts and sustaining contacts of the oil switch drop closed. These two sets of contacts are in series with potential transformer "B" and as they close the sustaining coil of the No. 2 oil switch is energized. It picks up, closing its load contacts to supply the load transformer.

Load is returned to the preferred feeder automatically as soon as potential transformer "A" becomes energized and picks up the MRR-LA relay.



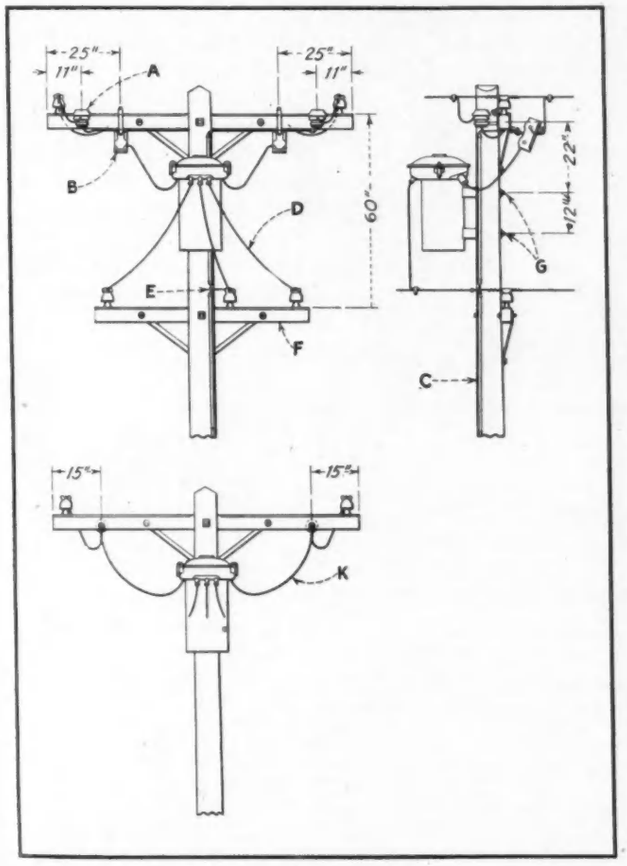
SIMPLE relay automatically transfers moderate loads between preferred and reserve feeders

HOW TO INSTALL

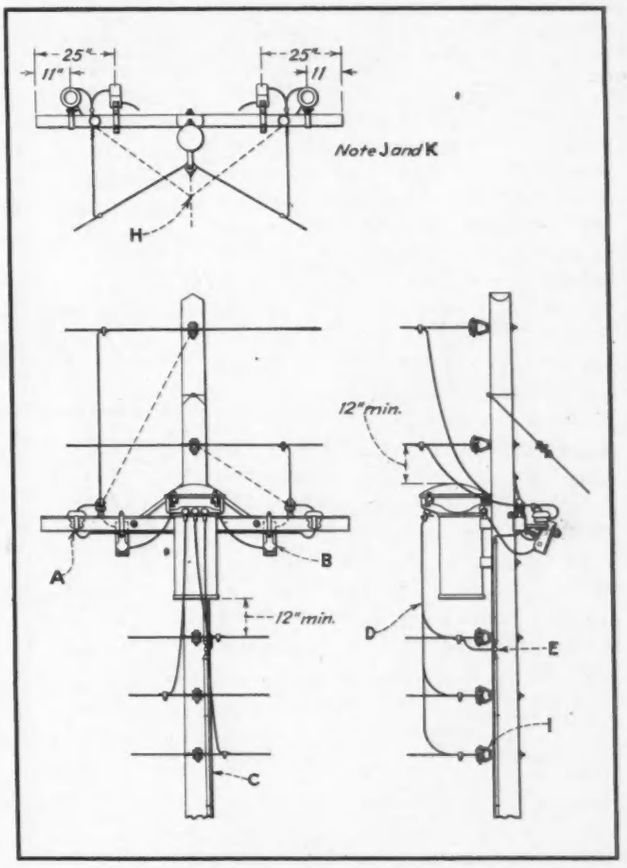
DISTRIBUTION TRANSFORMERS

Ratings: 1½ to 7½ kva. inclusive, 4,600/2,300-230/115 volts, single phase, 60 cycles

Arrangements shown in the accompanying sketches are for equipment mounted on poles which have straight-through runs or where the conductors are suspended at a vertical angle or are dead ended. These mounting arrangements are extracted from a book of standard practices of the West Penn System.



Installation With a Straight-Through Run



Installation at a Vertical Angle or Dead End

NOTES

A—Lightning arrester.

B—Fuse cutout.

C—Ground molding.

D—No. 4 weatherproof wire or larger for secondary risers.

E—Connect arrester ground to secondary neutral. Use 300-volt arrester between ground and secondary neutral where no water pipe grounds are available.

F—4-pin crossarm.

G—⅝-in. machine bolt.

H—Construction at dead end.

I—Spool clevis.

J—On single phase from 4,000-volt circuit omit cut out in neutral wire and use 300-volt arrester.

K—When self-protected transformers are used, omit cutouts and arresters and connect transformer primary to line with primary clamps.

More Steam—How?

12. Baffles Not Always Necessary*

By ALFRED IDDLES
Application Engineer Babcock & Wilcox Co.

The best baffle is one that doesn't exist. The next best one is made of water or steam tubes, either tangent or close enough together so that a closure can be made with studs or fins backed up by a sealing of refractory material of suitable kind. Where such construction is not possible, then of course baffles of the tile type applied to tubes are necessary in some cases and should be designed with ample support for their own weight and to withstand reasonable variations in furnace draft—in other words, puffs.

Usually baffles are installed for forcing gases over tube surface and the consideration is heat absorption. Usually draft loss is also considered, and rightly so. Some other considerations not often thought of, however, are to locate the baffles so that the turns do not consume too much power and so that the flow characteristics may really result in proper distribution of gas over the heating surface. The higher the gas velocity and resulting mass flow, the greater the heat absorption, other things being equal, but to follow this to the limit almost invariably results in trouble. This is especially noticeable on waste heat boilers, where large dust loading in the gas flow frequently results in cutting tubes or cutting clamp bolts or other structural devices installed in connection with the baffle. This has been very troublesome on some pulverized fuel jobs where attempts have been made to obtain exceptionally high mass flow. Tubes have been cut out in a few months and I suppose the moral is that one cannot have the maximum theoretically available efficiency without running the risk of getting into practical trouble.

Small changes in the length of baffles materially affect the shape of the flow curve around the end and changes may materially affect slag deposition. Providing an enlargement of space where the turn is made will frequently result in lower draft loss.

My principal point on this subject is to eliminate baffles wherever possible. Use metal baffles where temperatures will permit. Keep dampers in cold zones and make baffles out of tubes wherever possible. All of this is on the assumption that the operator wishes to keep out of trouble and that he can control his purchasing agent when the extra cost of this improved design is contemplated.

*This series began in the May 16, 1942, issue of "Electrical World," adapted from author's talk "What the Operator Wants to Know" to Steam Power Division, A.S.M.E., Metropolitan Section, March 25, 1942.

•

Boxes for Emergency Cable Joints

By R. J. RADCLIFFE*

The constant thought in the mind of a maintenance engineer is preparation for any eventualities which may arise to affect the smooth running of his plant. This is more than ever his thought in wartime, when the production of factories has to be maintained.

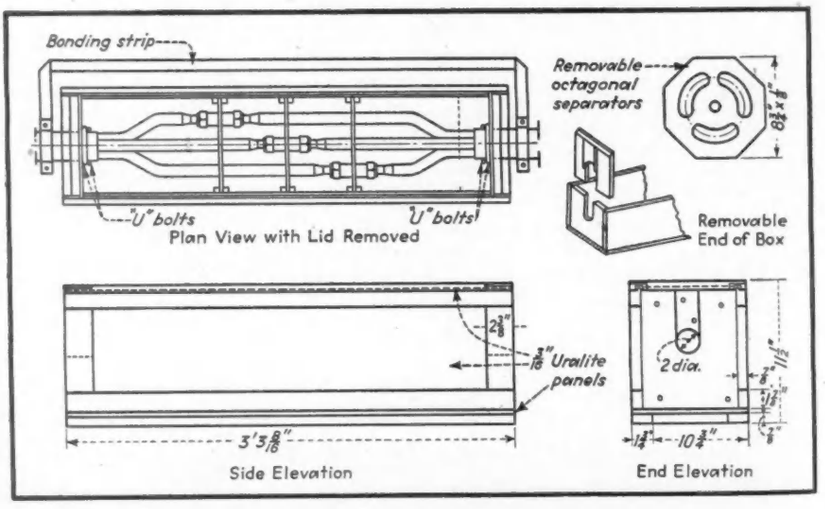
My factory, like all others in Britain, made early provision for possible bombing. One aspect of the problem is the speedy repair of cables damaged in air raids for which Dussek emergency joint boxes with accessories were provided.

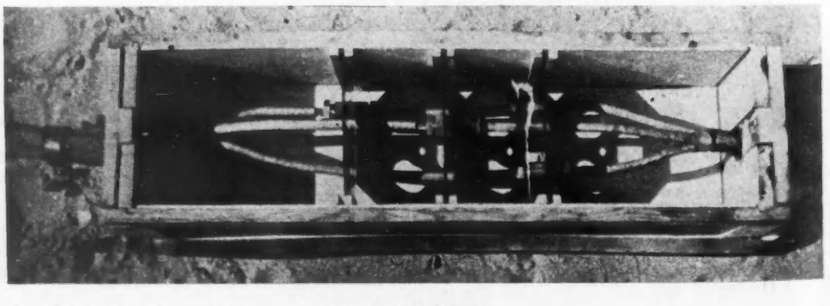
The box is made of a stout timber frame with Uralite panels, constructed in six sections which can be conveniently put together with wood screws. The ends are so arranged as to enable cable ends to be connected before placing in the box. The sealing of cable entries and the seams of the box is done with a special plastic compound supplied with equipment.

Separation of the cables in the box is arranged for by the use of three "Permali" (resin-impregnated compressed wood) boards, which slide into grooves. The separators are supplied either ready drilled for the cable to pass through, or plain.

For coupling the conductors solderless connectors are used. These couplings are "staggered" in the box. The compound filling can be either cold pouring or hot pouring, depending on the facilities available. We have arranged for only cold pouring compound to be used, bearing in mind the possible presence of coal gas.

*Brief mention of the Dussek box in "Electrical Review," London, caused "Electrical World" to apply to the British Information Services for details, which are here supplied by Mr. Radcliffe.





CONSTRUCTION and use of emergency joint box

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GENERAL ELECTRIC

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American steel producers and steel warehouses are mobilizing their sales personnel to help you do a 100% job of getting in the scrap

WE'VE called him Bob Martin for short. He may be a U·S·S salesman, or he may represent some other steel supplier. In any case, it's his job to help you get the steel you need for war production when you need it. Things being what they are, that's a tough assignment in itself.

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UNITED STATES STEEL

Should it be necessary to bury the box in the ground for any length of time, it can be painted with a good bitumastic solution. Under extreme conditions, consideration could be given to the use of bitumastic pressure-impregnated timber. We do not anticipate burying the boxes for any length of time, as they are intended purely as a temporary measure.

Bonding Armor

For bonding, suitable copper strips are used, attached to the armoring of the cable by means of two phosphor-bronze clamps, so as to obtain electrical continuity throughout the armoring. An iron cradle (not shown in the illustration) can be made, with cable clamps attached, so that by securing the cradle to the box both can be made rigid, preventing any movement of the joint in relation to the box. We rely on mechanically securing the cable to the box by using inverted "U" bolts, arranged to pass through the base and top of the box at the cable entries.

The construction of the box is very simple. It could, should the necessity arise, be put together on site. We have ordered only a limited number of boxes, but additional compound and connectors have been stocked to cover any emergency.

Should it be necessary, these emergency joint boxes could be used air filled, up to 11,000 volts for some hours, but it is important to wrap the ends of paper-insulated cable with a non-hygroscopic tape to stop ingress of moisture. Warning notices must of course be put up, and the whole covered by tarpaulin. With compound filling, cables should not be taped.

Except in a few minor cases there are no "T" joints in this particular factory, but if the necessity arose it would be a comparatively simple matter to make up a standard "T" beforehand, with cable ends, a few feet in length, cut, so that the connectors would be staggered in the box, using three temporary speed joint boxes on the site of the repair.

A high explosive bomb creates a large crater, sometimes as much as 50 ft. in diameter. There is always the likelihood of water, sewers and gas mains being present. With the consequent break in the cable run, the cable would commence to draw in water, and in no time a considerable length would be useless, due to breakdown of insulation.

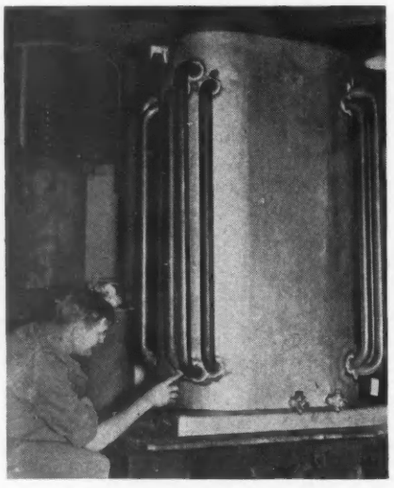
It is advisable to run the repairing cable parallel to broken cable (allowing sufficient length for a permanent joint at a future convenient date), so that it by-passes the crater and the buried cable. The damaged cable can then be opened out some way back from crater and the two emergency joints made.

It is estimated each joint box should take about 45 minutes to complete, without compound. If using a proper cold pouring compound the cable can be used immediately after pouring, on any voltage up to 400, but in the case of higher voltage it is advisable to allow one hour's setting time before placing the cable in use.

•

Added Tubes Restore Cooling Capacity

When fourteen transformers rated 50 kva., 33/2.3 kv., 25 cycles were rewound recently for operation on the Illinois-Iowa Power Company system as 100-kva., 33/6.9-kv., 60-cycle units, the new and larger windings reduced the amount of oil in the transformers and consequently the cooling effect. Lost cooling capacity was restored by welding thin-wall tubes to the transformer tank. Tubes added were of 12 gage steel, $2\frac{1}{2}$ in. in diameter and 52 in. long and are offset about $3\frac{1}{2}$ in. from the tank. It is estimated that the twelve tubes added to the transformer tank shown would increase the oil volume in the tank about 13 gallons and the cooling surface about 34 sq.ft. Addition of the tubes restored the balance between the core and oil capacity and the increased cooling surface reduced the operating temperature from 65 deg. to 42 deg. C. Work was done at the St. Louis shops of the Westinghouse Electric & Manufacturing Co.



THIN-WALL TUBES welded to rewound transformer restore lost cooling capacity

TRANSFORMER before addition of tubes

•

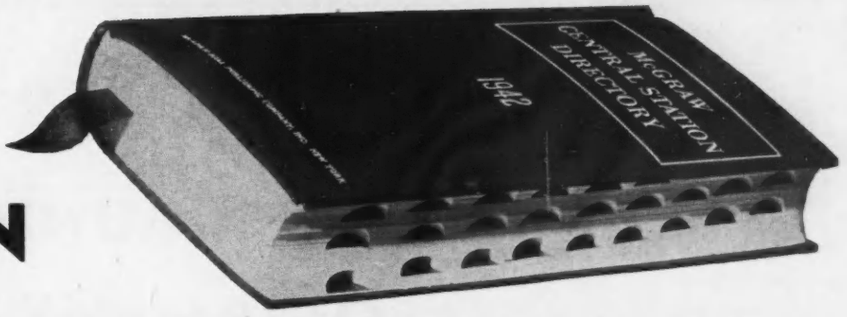
Flat vs. Sprung Arch for Dutch Oven

Boilers Nos. 7 and 8 in the plant of the Northwestern Electric Company, Portland, Ore., were originally equipped with Detrick suspended type flat arches over the Dutch ovens, hog fuel being normally employed in firing.

Under the conditions prevailing there, it has never been possible to control properly the air admitted to the furnaces. This was because particles of debris would get between the tiles as they crept and crawled due to expansion and contraction. Consequently, the tiles would never get back into place properly, permitting air leakage over the fuel bed.

When the suspended arch on No. 7 was due for replacement recently it was decided to replace it with a sprung arch. Since then much better efficiency has been obtained in the operation of the boiler as well as increased load capacity. No. 8 will be treated in the same way when the time comes for replacement, which will be about next year.

NEW 1942 EDITION



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HOW* TO OPERATE AND MAINTAIN

CARRIER COMMUNICATION EQUIPMENT

CARRIER CURRENT

General: Power line carrier current telephone equipment consists essentially of a transmitter, very similar to a radio broadcasting transmitter; a receiver, similar to the ordinary radio set; together with automatic telephone apparatus for signaling and necessary coupling and protective equipment for tying into the power conductors. The telephone set in itself is the same as the ordinary telephone and should receive the same care and attention.

OPERATION

Calls are received and answered in the same manner as with an ordinary telephone. In calling:

Determine if line is busy. Either signal lights or tone are provided at all installations for checking. If line is busy, *do not* attempt to call, since existing conversation will be interrupted and your call not completed.

If line is not busy:

Lift receiver, being careful not to "jiggle" hook switch (making and breaking contact on hook switch sends out an additional impulse and results in an incompleted call or ringing of wrong station), dial number for station desired, wait till station answers. In case station does not answer in a reasonable time, replace receiver on hook, wait five or ten seconds (this wait is necessary to allow equipment to reset) and call again as above.

MAINTENANCE

Batteries: Good batteries are most essential and should receive the same care and attention given station storage batteries. Keep battery clean, all connections tight and electrolyte at proper level by adding *distilled water only* to replace evaporation. *Never* add acid. Detailed instructions are posted at all installations, and daily or weekly reports must be forwarded to communication division.

Protective and Coupling Equipment: These items require no routine maintenance other than inspection. Spark gaps and fuses are to be inspected periodically. *Caution:* In replacing fuses always ground out coupling wires or condenser. Grounding switches are provided for this purpose.

Motor-Generator Set: Keep motor-generator set clean, wipe off dust and dirt at least once a week. Clean commutator with a rag semi-monthly, in case of sparking clean with very fine sandpaper (No. 00). *Never* use emery cloth for this purpose. Check operation of M.G. set daily by calling some other station. Motor-generator set does not differ essentially from other rotating machinery and same care and attention are necessary.

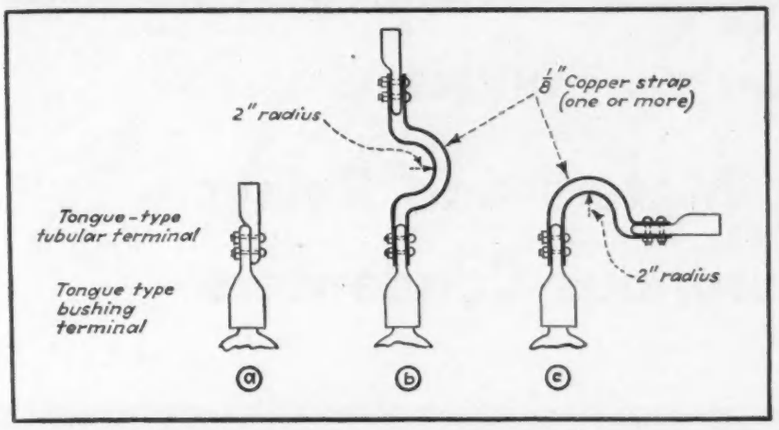
Transmitter: The transmitter is a separate unit on high power equipment and is combined with the receiver on low power sets. Daily operating reports are required; give complete information requested on forms. In case of trouble inspect all tubes to see if they light properly, see that all relays are free and contacts clean. Use a soft brush for cleaning inaccessible parts. *Caution:* Wait till "plate" voltmeter reads zero after power is off before touching any live parts. This is necessary since filter condensers may hold a dangerously high charge for an appreciable time. Always pull a.c. supply switch before working on transmitter, otherwise set may be started from the office and high voltages encountered. *Do not* change any relay adjustments without specific instructions from communication division.

Receiver: Troubles on receiver are usually due to either burned-out tubes or relay contacts. Be sure all tubes are burning at proper brilliancy, all relays are free and all contacts clean. No adjustments are to be made on any relays, condensers or rheostats except by representative of or on specific instructions from the communication division.

Station superintendents are responsible for the proper attention and maintenance of sets in their station as outlined in above instructions. In case of trouble which cannot be located as outlined above, notify the communication division immediately.

Summary: Keep your set clean. Practically all relay troubles are due to dust and dirt. *Do not* change adjustments. *Keep batteries clean and fully charged. Always replace covers on relays and panels. Send in complete reports promptly. Notify communication division promptly of troubles which cannot be cleared readily.*

*According to system operating procedures of the Alabama Power Company



COPPER BAR used instead of copper braid between bushing and bus—(a) as specified. (b) arrangement for vertical take-off. (c) arrangement for 90-deg. take-off

Bar Instead of Braid for Flexible Joints

A substitute for the conventional copper flexible braid used to facilitate expansion between bushings of transformers and breakers and the bus work to which they are attached has been devised by engineers of the Commonwealth & Southern Corporation, Jackson, Mich. The accompanying sketches show the method that was used.

Transformers or other apparatus bushings are specified with flat-tongue terminal and corresponding flat-tongue tubing terminal, as shown in (a). On installation the bushing terminal and tubing terminal are joined with an appropriate number of ⅛-in. copper bars bent and arranged according to the direction of take-off as shown in (b) and (c).

The copper bar is bent in a 2-in. radius.

•

Use Labor to Conserve Material

Illustrating how use of operating labor is being effectively applied in power plants and other utility properties to conserve strategic material is an instance encountered recently at Cahokia station of the Union Electric Company of Missouri. Here, in accordance with governmental recommendations, the company is increasing its yard coal storage capacity 75,000 tons or about 40 percent. This is being done to guard against a possible shortage of coal transportation facilities during the winter of 1942–43 that could curtail power production.

To place the additional coal in two piles at Cahokia would require 3,800 ft. of railroad track and accessory hardware. A search of the system uncovered 1,900 ft. of available track, hardware, switchpoints, etc., at one of the hydro plants where it had been used for a construction project some years ago. A little thought revealed that this amount of track could be made to serve satisfactorily if half the coal (one pile) was put down and the track then transferred to the location of the second pile. Thus at the expense of moving the track from the first location to the second half the initially estimated track required was made to do the job.

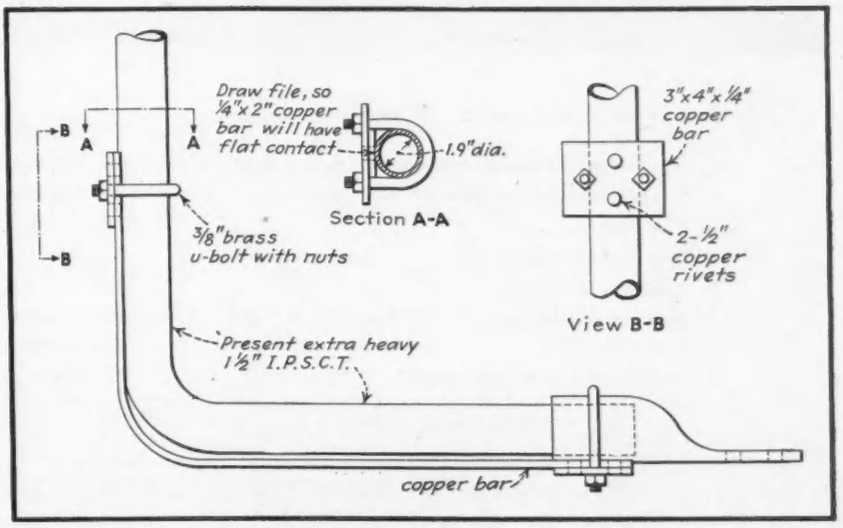
It is interesting to note that the Union Electric Company's surplus equipment department was the agency through which the used track was found. This department maintains a catalog of all surplus or available unused equipment on the property, complete with a description of the equipment, rating, manufacturer's identification and company number. All departments of the company are provided with copies of the catalog lists for reference. Thus it is possible for any department to locate available, usable, surplus materials and equipment of all kinds and requisition them for use without having to purchase new. The surplus equipment catalog is revised continuously and equipment that cannot be used is sold to used equipment dealers or disposed of as scrap.

•

Increasing O.C.B. Lead Capacity

By V. D. HOLLIS
Operating Department, Central Illinois Public Service Co., Springfield

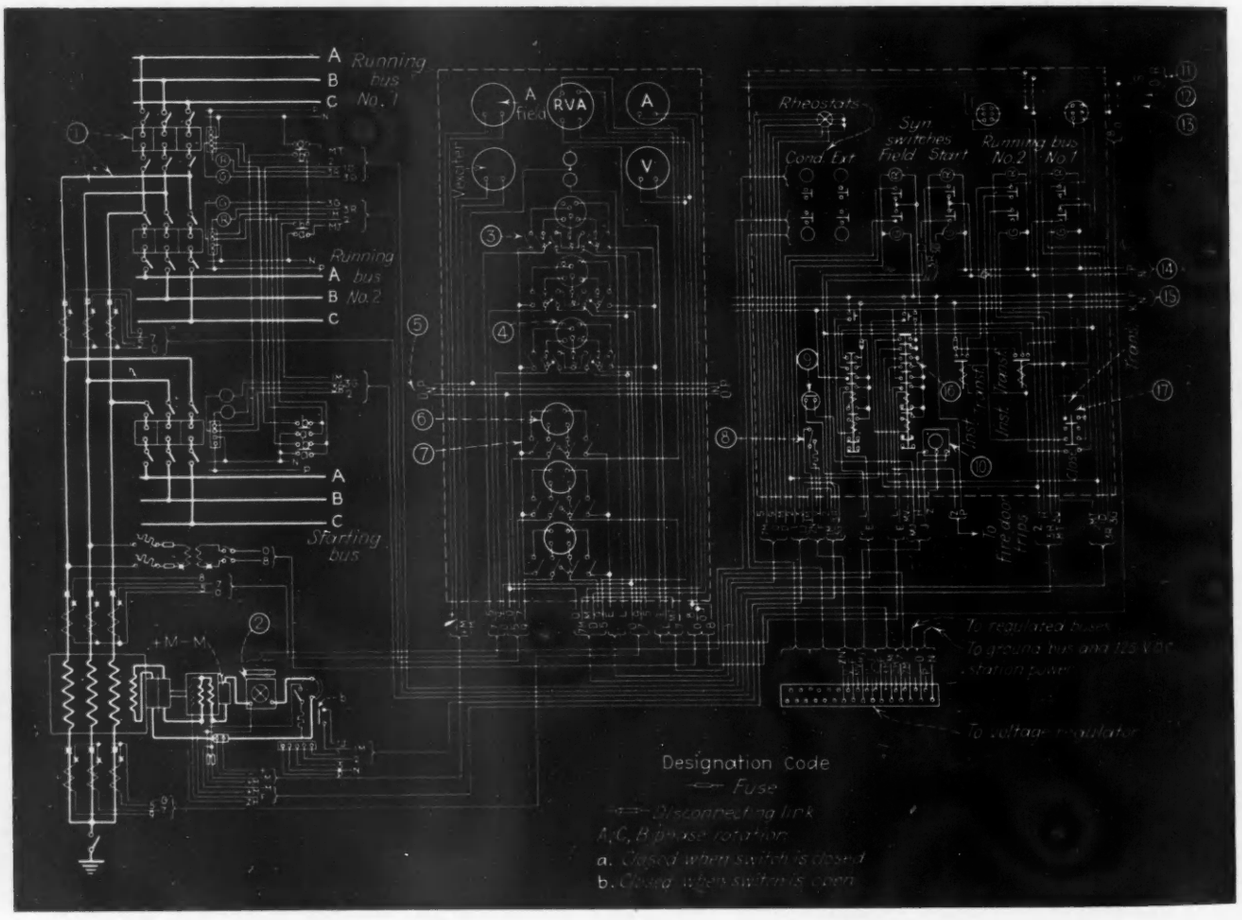
Due to increased load on certain oil circuit breakers which were installed during the last World War period, it was found that a serious heating condition had developed in the 1½-in. extra heavy copper tube fittings of the sweated type that were used in making up the oil circuit breaker leads. This was overcome by the addition of a shunt strap of ¼x2-in. copper bar attached as shown in the illustration below.



DETAIL of shunt strap to increase lead capacity

HOW TO CONNECT

Controls, Meters and Relays for Synchronous Condensers

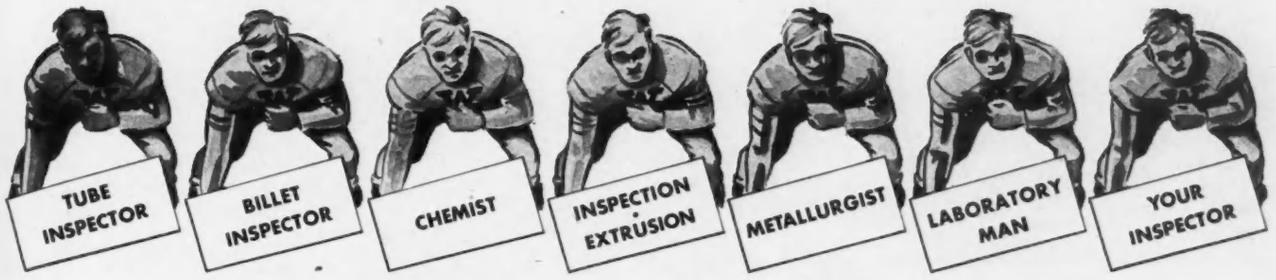


References for circled numbers on diagram:

1. **Interlocked starting and running switches.**
2. **Meter-controlled condenser field rheostat.**
3. **Test blocks.**
4. **Differential relays.**
5. **Auxiliary control.**
6. **Overcurrent relays.**
7. **Test blocks.**
8. **Exciter field discharge switch.**
9. **Regulator cutout.**
10. **Voltage adjusting rheostat.**
11. **Synchronizing bus.**
12. **No. 2 bus potential.**
13. **No. 1 bus potential.**
14. **Low-tension all circuit breaker control.**
15. **Auxiliary control.**
16. **Auxiliary relay.**
17. **Interlock by-pass.**

* From a book of standards of a Western utility organization

No defective billet can crash this line



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Flying Particles Cause Lamp Failure

Repeated failure of fluorescent lamps for no evident electrical reason in a Detroit industrial plant engaged in the manufacture of aluminum castings recently led its engineers to make an interesting discovery regarding the effect of flying metal particles on fluorescent lamp life.

At the plant in question the fluorescent lamps giving trouble were

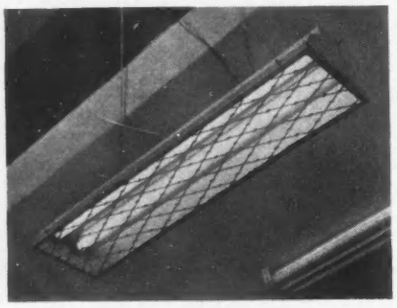


PLATE GLASS SHIELD over industrial fluorescent fixture near grinding machine stops trouble from tube puncture

mounted 3 ft. above a grinder where aluminum castings were being processed. The lamps were mounted in an open industrial type reflector. Close examination of the lamps that had failed after abnormally short life revealed that minute particles from the grinding operation had actually made minute punctures in the glass tube, allowing air to enter and thus render the fluorescent lamp useless.

The trouble was remedied quickly by putting a plate glass cover over the bottom of the reflector and holding it in place with an angle iron frame. To prevent the glass from falling in case of breakage, a diamond mesh screen painted white was welded to the frame to give more support to the glass.

•

Slide Rule Yields Primary Fuse Sizes

By J. B. HODTUM
Allis-Chalmers Manufacturing Company

Load that may be delivered by a distribution transformer is in most cases limited by the voltage regulation, rather than transformer thermal capacity. Determination of the proper primary fuses for distribution transformers is, therefore, a case of selecting a size that will operate on secondary faults that produce the minimum primary short-circuit current. The accompanying distribution slide rule has been devised as an aid in the calculation of primary fuse sizes.

Transformer short-circuit current is a function of transformer impedance, wire size and lengths of secondary circuit. However, the primary fault current also depends upon whether the fault occurs at 240 volts or at 120 volts on a three-wire connected secondary.

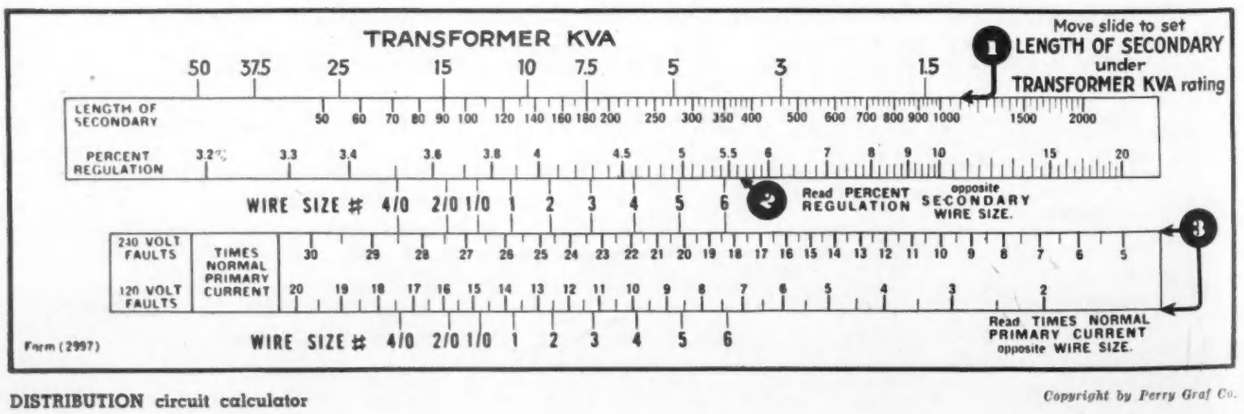
If the transformer is to sustain voltage balance, for unbalanced secondary loads, impedance between halves of the secondary windings must be low. Impedance of each 120-volt coil to the primary coil is nearly the same as impedance of the full winding to the primary winding. A fault on the 120-volt connection of a three-wire-connected transformer will deliver about the same primary current as though the complete secondary winding was shorted. Since the ampere turns in the primary winding equal those in the secondary, amperes in the secondary, for a 120-volt fault, will be two times that for a 240-volt fault. For each case, however, the primary current would be about the same.

A fault immediately adjacent to the transformer would yield two times the short-circuit current in the secondary and the full short-circuit current in the primary. As secondary circuit is added primary fault current for a 120-volt fault decreases more rapidly than for 240-volt fault.

By setting the maximum length of secondary circuit (one way) on the calculator below the transformer kva. rating on scale 1, the primary current in number of time rated current of a 240-volt fault is indicated in the upper scale of slide 3 below the size of secondary conductor. Above the wire size the lower scale of slide 3 gives primary current in times rated current for a 120-volt fault for a three-wire connection. In both cases the fault is assumed to occur at the end of the secondary circuit corresponding to the number of feet opposite the transformer rating. Proper fuse will then be the largest one that will blow at the current value given in the lower scale of slide 3.

Regulation, read above wire size on scale 2, assumes that all of the load is at the end of the secondary. In most cases, especially where the secondary is of considerable length, the load may be uniformly distributed over the entire length. To find regulation for distributed load, reset the rule placing, below transformer size, a length of secondary circuit of one-half the actual length. If the transformer is supplying a load feeding in two directions and uniformly distributed, the regulation is obtained by setting below the transformer size a distance equal to ¼ the actual length of one branch of the circuit.

Actual regulation, however, will be somewhat greater than this since load


TRANSFORMER KVA
50 37.5 25 15 10 7.5 5 3 1.5
1 Move slide to set LENGTH OF SECONDARY under TRANSFORMER KVA rating
LENGTH OF SECONDARY
50 60 70 80 90 100 120 140 160 180 200 250 300 350 400 500 600 700 800 900 1000 1500 2000
PERCENT REGULATION
3.2? 3.3 3.4 3.6 3.8 4 4.5 5 5.5 6 7 8 9 10 15 20
WIRE SIZE # 4/0 2/0 1/0 1 2 3 4 5 6
2 Read PERCENT REGULATION opposite SECONDARY WIRE SIZE.
3
240 VOLT FAULTS
TIMES NORMAL PRIMARY CURRENT
120 VOLT FAULTS
30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5
20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2
Read TIMES NORMAL PRIMARY CURRENT opposite WIRE SIZE.
Form (2997)
WIRE SIZE # 4/0 2/0 1/0 1 2 3 4 5 6

DISTRIBUTION circuit calculator

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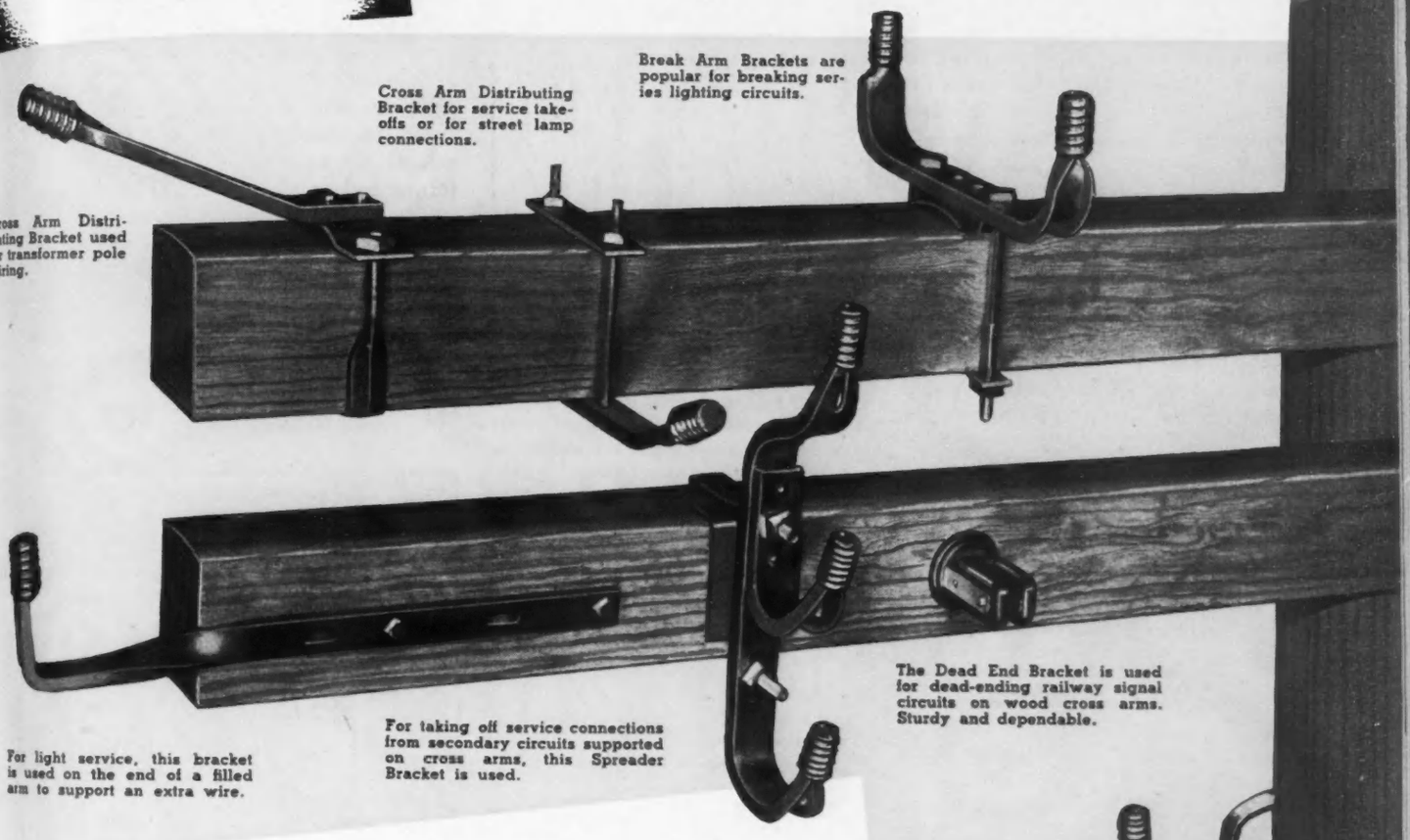
OLIVER BRACKETS
for Cross Arm and Pole!



Cross Arm Distributing Bracket for service take-offs or for street lamp connections.

Break Arm Brackets are popular for breaking series lighting circuits.

Cross Arm Distributing Bracket used for transformer pole wiring.

The Dead End Bracket is used for dead-ending railway signal circuits on wood cross arms. Sturdy and dependable.

For light service, this bracket is used on the end of a filled arm to support an extra wire.

For taking off service connections from secondary circuits supported on cross arms, this Spreader Bracket is used.

Forged Hook Brackets are used in running secondaries and in making service connections. Forged from mild open-hearth steel.

Pole Brackets, made from channel steel, are used for running circuits on transmission poles.

SOME of the more popular Oliver Brackets are shown in the above illustration—each designed for a specific application or service.

Hot forged or rolled from mild open-hearth steel, thoroughly protected by hot dip galvanizing, designed for easy installation, rigidity and prompt drainage, Oliver Brackets are your best choice always!

Write today for complete information on Oliver Pole Line Materials.

OLIVER
IRON AND STEEL
Corporation

Makers of Pole Line Materials Since 1894
PITTSBURGH, PENNSYLVANIA

★ ★ ★ ★

COOPERATING IN WAR PRODUCTION

will be distributed in lumped values rather than uniformly distributed.

The rule may also be used to find the length of circuit and size of wire when the transformer size is known and where it is desired to obtain a given regulation. The regulation is set above the wire size of scale 2 and the length of circuit is obtained by reading the distance in feet below the transformer rating of scale 1. This procedure likewise sets up secondary short circuit current on scale 3.

Fault current and regulation values include the characteristics of the transformer and the secondary circuit and assume infinite capacity on the high-voltage systems at the transformer. The percent regulation is the value which would be obtained at a power factor of load which would give the maximum regulation.

•

Relay Inverse Time Characteristic Doubled

By GEORGE STEEB
Relay Engineer, Buffalo Niagara & Eastern Power Corporation

Use of standard overcurrent relays for the protection of circuits often results in excessively long back-up relay times; increased damage to equipment and, under certain conditions, instability of the system may result. To overcome this disadvantage a method has been developed of modifying the conventional inverse time characteristic of an induction relay by using an instantaneous attachment to provide a lower inverse-time characteristic at currents above a certain value. Internal connections of a Westinghouse type "CO" overcurrent relay with an instantaneous attachment connected to produce the desired result are shown in Figs. 1 and 2.

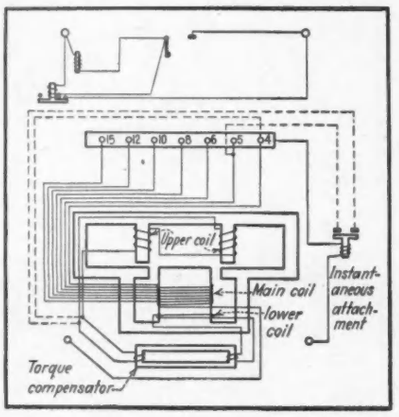


FIG. 1—With relay set on tap 4 corresponding section of main coil is connected in parallel with upper coil and secondary of torque compensator through contacts of instantaneous attachment

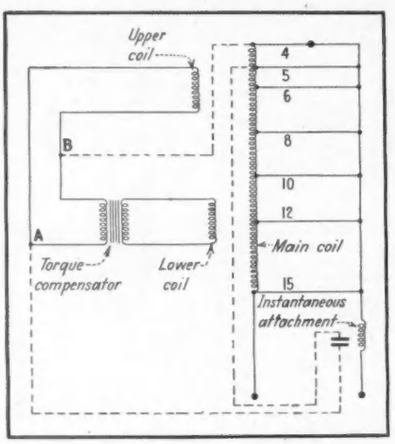


FIG. 2—Instantaneous attachment closes contacts at predetermined value of current to shunt a portion of it through upper coil. Very little will flow through torque compensator because of its relatively high impedance

Use of this principle provides an inexpensive means of reducing the back-up relay time on radial circuits, a result which could otherwise only be obtained by the use of more expensive and more complicated relays. This same principle can be applied advantageously in distribution circuits where fuses and relays have to be coordinated.

The effect of the current by-passed from the main coil into the upper coil of the relay is to increase the torque and speed of relay (Fig. 4).

There must always be available at least one tap on the main coil above the one on which relay is operated.

By interchanging the connections at points A and B (Fig. 2) the current from the main coil will oppose the normal current produced in the upper coil by the torque compensa-

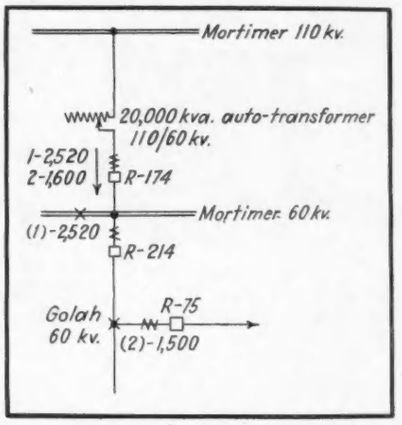


FIG. 3—Typical application of double inverse time characteristic
Three-phase short-circuit values in amperes at 60 kv. Breaker R-214 equipped with type CO induction overcurrent relays with instantaneous trip attachments set to pick up at 1,800 amp. primary current. Breaker R-174 equipped with similar relays but modified as shown in Figs. 1 and 2.

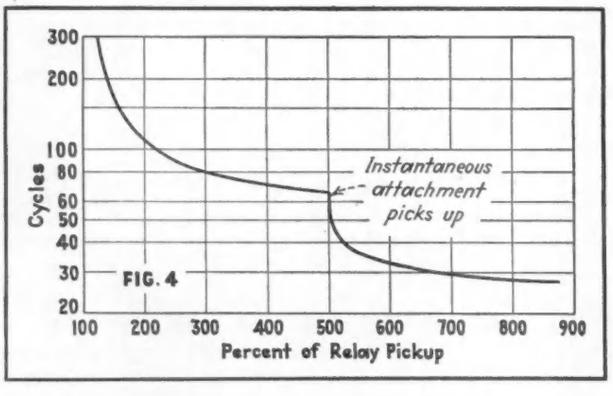


FIG. 4—Time above 500 percent of pick-up is reduced

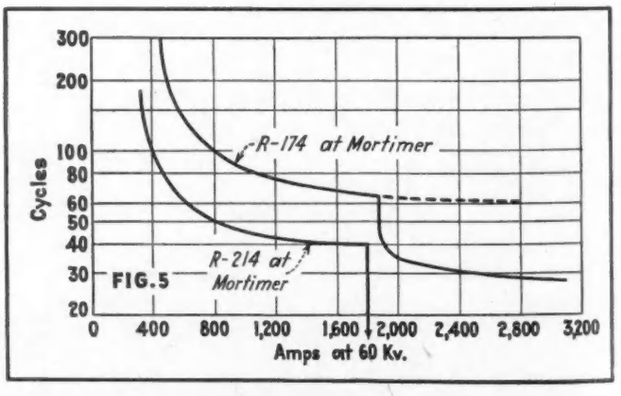


FIG. 5—Coordinated time characteristics of modified (R-174) and conventional (R-214) overcurrent relay at Mortimer bus

Fig. 4—Pickup of the instantaneous attachment can be adjusted to vary the point of flexure by including a larger part of the main coil in parallel with the upper coil; *i.e.*, changing to tap 6 or a higher tap.

SCRAP piles are much more than mere collections of trim ends, cuttings, useless machines, parts and junk these days. They're vital national resoures—*American Treasuries*, in fact, in this critical year; because the nation's steel producers will need several million more tons of scrap in 1942 than ever before, if the demands of war production are to be met. • How much can *you* contribute? Not just the usual scrap flow from your operations, but *all* the idle metal around your buildings and yards that it isn't absolutely essential to keep. Your deposit in the scrap bank will pay dividends all over the world—*make it a real one!*

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

STEEL-MAKERS TO THE ELECTRICAL INDUSTRY

tor and therefore block the relay. This connection can be used to prevent a breaker tripping when the short-circuit current exceeds its interrupting rating.

Typical application of this relay combination (Fig. 3) shows the three-phase short-circuit values at two points on the circuit. Time characteristics (Fig. 5) of these relays are such that three-phase faults on most of the line from Mortimer to Golah will operate the relays of breaker R-214 at Mortimer in one cycle. The relay time of R-214 for a fault at Golah is 40 cycles, which is necessary to provide selectivity between R-214 and R-75 at Golah.

To provide selectivity between R-174 and R-214 at Mortimer the time of the relays of R-174 at 1,800 amp. primary current (the point at which the instantaneous attachment of R-214 operates) must be about 66 cycles. The dotted line shows the time characteristic of the relays of R-174 at primary currents above 1,800 amp. using a conventional relay. From this curve it can be seen that the relay time of breaker R-174 for a fault on the 60-kv. bus at Mortimer would be about 62 cycles. This relay time plus the operating time of breaker R-174 gives a total clearing time of not less than 78 cycles for a fault on the 60-kv. bus at Mortimer. A fault of this magnitude, lasting for this length of time, would probably cause instability of the 110-kv. system back of Mortimer. A similar situation would arise if, for a fault on the line between Mortimer and Golah, breaker R-214 at Mortimer should fail to operate.

The application of the above described relay on breaker R-174 reduces the relay time of R-174 for a fault on the 60-kv. bus at Mortimer to about 30 cycles. The total clearing time of breaker R-174 will then be about 46 cycles, a time short enough to prevent instability of the 110-kv. system.

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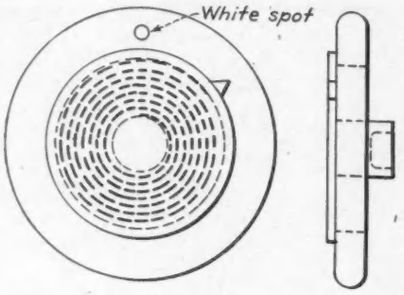
Torque Tester for Register Motors

Type B-7 demand register motors are given a quick torque test in the meter laboratory of the Philadelphia Electric Company by means of the simple device shown in the accompanying sketch. The gadget consists



DEMAND REGISTER motors are checked by this torque tester

of a flat ring of Bakelite inside which is a coil spring whose outer end is fixed to the ring. The inner end of the spring is fastened to a brass hub which fits over the gear on the end of the motor shaft. The hub plate carries a small pointer moving around on the face of the Bakelite ring on which a white dot is marked.

With the spring free of torsion the pointer is at rest some distance from the white dot. Then when the motor is started and begins to tighten the spring the pointer moves toward the dot and may pass it, depending on the torque exerted by the motor. The pointer comes to a stop as the motor stalls. The spring is calibrated so that movement of the pointer to the dot indicates a satisfactory motor torque.

•

Glass Insulation Speeds Brass Melting

With mica listed as one of the nation's critical materials, the Western Cartridge Company has successfully used Fiberglas tape in place of mica as coil insulation in the primary coils of induction-type brass furnaces.

The 38 furnaces of this type installed in the Western Cartridge Company plant have a sleeve-shaped form composed of ceramic material which retains the helical flat copper coil. Fiberglas tape is spiraled between turns in the coil to form a double helix composed of alternate layers of copper and Fiberglas tape.

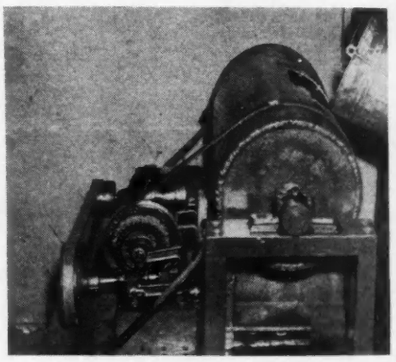
Use of the Fiberglas tape insulation made it practicable to increase furnace temperatures to the point where it was possible to produce five pours of 1,500 lb. each during each eight-hour shift, whereas with the mica insulation the limit was three pours of 1,500 lb. each during each eight-hour shift—an increased production of 3,000 lb. per shift, per furnace.

The cost of the glass fiber insulation was 50 percent less than the mica it replaced. The number of man-hours required to install the Fiberglas insulation was less than half that required for the installation of mica.

•

Scrap-Made Machine Salvages Connectors

For cleaning used solderless connectors, bolts, nuts and other small items of hardware a machine that itself was assembled from scrap parts is employed in the Albany storeroom of the New York Power & Light Corporation. Built to no specification except that of making use of whatever was available, the machine, as appears in the accompanying illustration, does a very good job. The cleaning solution is kerosene, into which is stirred a generous hatful of buckshot. After a vigorous tumbling the cleaned parts are sieved out and the kerosene and buckshot returned to the barrel for another charge.



TUMBLER BARREL receives a charge of corroded connectors, bolts and nuts, and, below, sieve separates cleaned charge from kerosene and buckshot

General Electric Photos

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(This test was described in a Shell Turbo Oil advertisement dated January, 1941)

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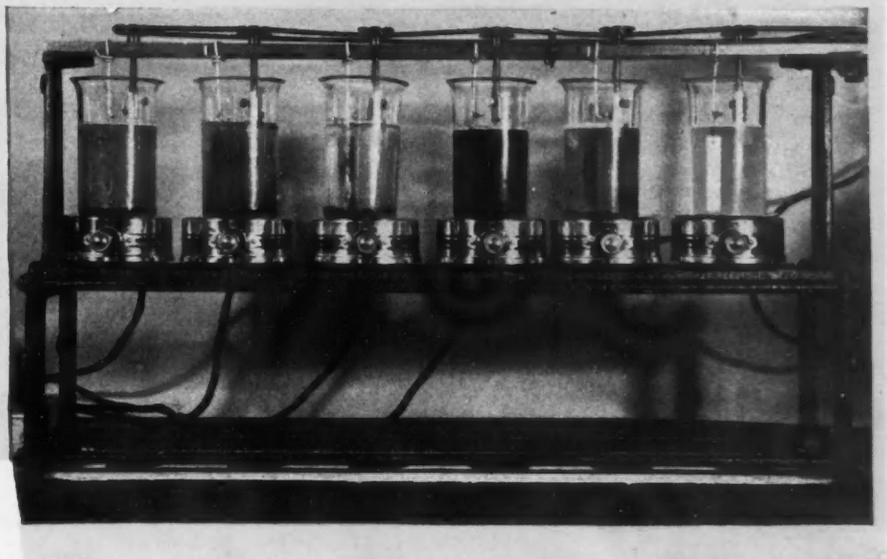
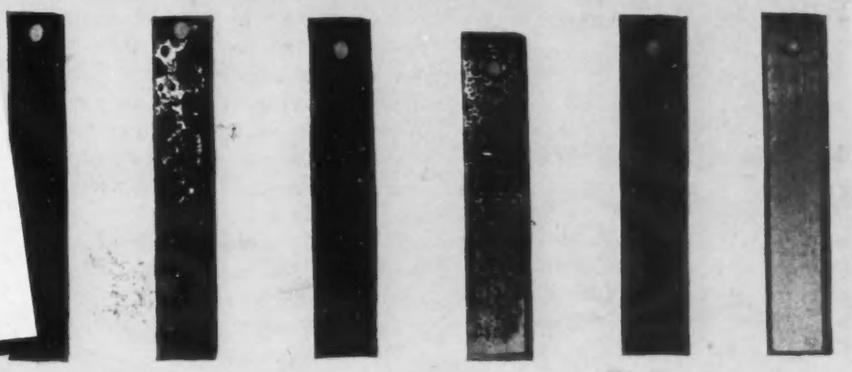


The Turbine Oil that PREVENTS Rust!

These six steel test strips prove Shell Turbo Oil positively prevents rusting. All six strips were immersed for 48 hours at 167° F. in well-known turbine oils, mixed with 10% of distilled water and continuously agitated at 1200 R. P. M. Right-hand strip, immersed in Shell Turbo Oil under these severe test conditions, shows no rust. All of the other strips rusted badly.



PUBLISHED by the AMERICAN SOCIETY FOR TESTING MATERIALS AS TENTATIVE STANDARD . . .

a turbine oil rusting test

AT ITS 1942 ANNUAL MEETING, the American Society for Testing Materials adopted as tentative standard D665-42T, a turbine oil rusting test similar to that shown above.

Here is *official* recognition of the importance of the rust-preventive effect of modern turbine oil! For more than two years, the superiority of Shell Turbo Oil in preventing rust has been consistently proved by the test illustrated.

Two other features of Shell Turbo Oil, *high oxidation stability*, and *minimum foaming tendency*, make it equal to every requirement of modern turbine lubrication.

SHELL

SHELL TURBO OIL

LOAD SERVICING

Industrial • Commercial • Rural • Residential

About Irreparable Appliance Parts

B. P. BOVARD*

Many agencies operating within the electrical industry have placed particular stress on the "Repair—Don't Replace" story during the last month or two. This has been done in an effort to conserve as many new parts as possible for future use. It is vitally important that this conservation plan be adopted by all repair shops, not because there is any serious shortage of parts at the present time, but simply in an effort to save vital parts for future use. If every shop will adopt the "Repair—Don't Replace" policy the industry, as a whole, will benefit.

However, it is realized that certain appliance parts, due to a worn or broken condition, are beyond repair. When this happens replacement is necessary in order to keep the appliance in operation. In many cases the question arises, "What disposition should be made of the old part?" Some manufacturers request that the old part be returned to the factory before the new part is shipped. Where this is the rule, we must, of course, comply if we are to carry on our service. While this policy has become necessary in some cases, it is realized by all concerned that it is not an ideal situation and definitely slows up service. Already some manufacturers are attempting other means of entering into the conservation program wholeheartedly, and at the same time to give a type of service that will greatly speed up service to the dealers and, of course, make it possible for them to render prompt repairs for their customers.

The policy, as set up by one manufacturer, permits the dealer to accumulate all the old parts and scrap material and sell it to a local scrap man with the provision that he obtain from the junk dealer a certificate like that shown here.

The success of this plan, of course, depends on the cooperation by dealers.

The outright sale of new parts, made of or containing a large percentage of critical materials, is discouraged unless the old parts are retained by the dealer. This policy, if and when adopted, will not only speed up service, but will also relieve the transportation problem. The accumulated receipts collected by the manufacturer should equal in pounds the amount of new parts shipped, if the proposed plan is successful.

* As reported in Duquesne Light's *Electrical Service News*

This is to certify that on.....(Month) (Day) (Year) we received.....pounds of scrap*.....washing machine parts from.....for the account of Blank Washing Machine Corp., New York.

.....

Witness.....

* Indicate Brass, Copper or Aluminum

SUGGESTED FORM of receipt for scrapped appliance parts

Maintenance Fill-in Holds Service Up

By J. S. BOURNE, J. C. RICHERT, Jr.
Carolina Power & Light Company*

[Preventive maintenance of outside plant can do a great deal to hold off and to limit the lowering of customer service standards which is apparently inevitable. Also, this field of activity furnishes useful work to line supervisors and crews with nothing much to do now that normal distribution construction is practically out for the duration.—EDITOR'S NOTE.]

In an effort to make every skilled man-hour productive, we started in January a planned program of preventive maintenance. Inspectors have been assigned definite territories and a pole-to-pole inspection of our distribution system is now nearly complete. The inspections have been made by supervisors or foremen working in other than their own districts. In making these inspections, attention has been given primarily to hazards or potential hazards, items of preventive maintenance, and items requiring the use of little if any critical material.

We are attempting to bring our system up to A-1 condition while skilled man-hours and material (even though limited) are available. The inspector, from his field notes, prepares necessary work orders, estimates time and material required for each job, and groups these work orders as to location. In the average district, made up of a number of small towns, this method of having a full file of prepared work orders conserves both man-hours and tire-miles, because when called to an outlying town to do a small job the foreman takes along additional maintenance orders to complete the day's work.

We are thoroughly sold on the pro-

*From paper to Engineering and Operation Section, Southeastern Electric Exchange.

"Gramp" YAEGER'S BACK ON THE JOB!

"Gramp" Yaeger's typical of the thousands of skilled old-timers in industry able to continue doing *precision* work . . . if you give them the kind of man-made daylight provided by MILLER *Continuous* Wireway Fluorescent Lighting System . . .

WPB says, "When old-timers are provided with good lighting, tailored to their needs, it is frequently possible for them to keep on doing the precision work for which they are fitted."

MILLER 50 FOOT CANDLER or 100 FOOT CANDLER will provide war industry with fine, man-made *daylight* . . . adequate, productive illumination evenly distributed over every working surface. MILLER TROFFERS will duplicate that performance in plant offices and drafting rooms.

This better lighting will actually make war workers see better, feel better, work better. It will help speed production, cut down spoilage, improve worker morale, reduce accidents, and make for smoother-running plants. It is constructed to effect savings in critical materials . . . in installation time and dollars . . . and to help power conservation.

Just under 100 years of lighting experience . . . working with incandescent, fluorescent and mercury vapor . . . has enabled MILLER to offer through its engineers a lighting "expertness" which is at your command . . . to provide the best type of lighting system for your customers now in war production. *Write or wire us today* and we'll get on the job at once.

BUY U. S. WAR BONDS

MILLER

50 FOOT CANDLER
100 FOOT CANDLER
MILLER TROFFERS
Continuous Wireway Fluorescent Lighting Systems

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844

● MILLER offers a complete line of filament and fluorescent lighting equipment.

A MILLER Message inspired by WPB's helpful handbook, "Plant Efficiency."

Informing Customers

UTILITY takes space in local newspapers to tell how its generating capacity is being used in war effort

gram and we are convinced that it offers one way of offsetting some of the factors which will of necessity continue to lower our standards of service.

Training Employees for Possible Shifts

The serious problems of personnel shortages which often find vital work piling up while a new employee is being hurriedly familiarized with the job are being solved at New Orleans Public Service Company, New Orleans, through "advance training" of employees to fill all places subject to vacancies for any reason.

Under this "advance training" program, inexperienced girls having completed a business course in addition to a high school education are taken into the organization and trained in the operation of various types of business machines, so that they are fairly competent operators by the time they are called upon actually to perform the work as replacement employees. Experience to date indicates that in some instances girls are making better performance records than boys on jobs which, it was formerly considered, could best be done by male employees.

Vacancies in administrative positions, occasioned by men leaving for service in the armed forces, are filled by the temporary advancement of other men whose training and experience has placed them in line for such advancement. Women employees are being substituted for practically all other office work, including clerical and customer contact positions involving both personal and telephone contacts. Here, too, most of the new employees have had little or no previous experience, but the "advance training" smooths the path for the maintenance of proper handling of duties when they are fully assumed. As vacancies occur "trainees" are used for replacements and new girls employed for training.

Says E. T. Colton, secretary-treasurer of the company:

"With careful selection of the prospective employee and with adequate training before imposing responsibility, there is little danger of unfavorable experience later on, and our own record bears this out. All in all, I think it fair to state that the women are doing a very satisfactory job in the capacities mentioned above. Certainly the rate of turn-over with women is substantially less than it would be were men employed during these times."

Sprocket Hardening With Induction Heat

Doubling the speed in which 28-in. sprockets of heavy-duty tractors are hardened is accomplished by means of a Tocco machine which is installed in the plant of the Cleveland Tractor Company.

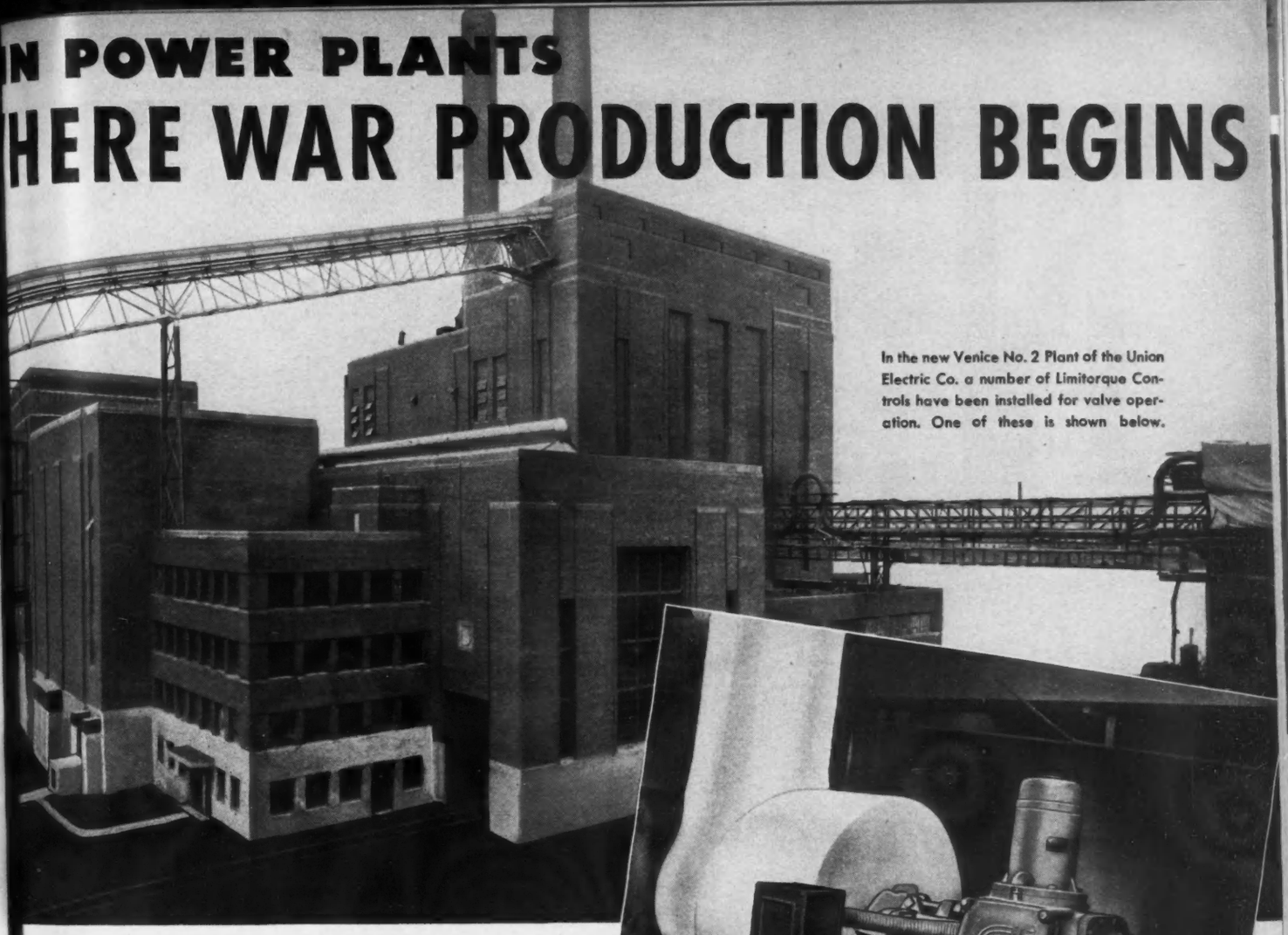
Previously only six to eight sprockets could be hardened in an hour. But now approximately fifteen may be processed. The operator places three sprockets into the Tocco machine at one time. The induction block of the machine contains three inductors, each surrounding a sprocket area under treatment. High-frequency current flowing through the inductors sets up a current in the sprockets, heating the metal to 1,500 deg. F.

Heat is maintained for ten seconds, and then the current is automatically shut off. A stream of water then is turned onto the metal, which is quenched for ten seconds. As one cycle of heating and quenching is completed, the operator pulls the sprockets from the inductor block, sets the index on the fixture and moves them forward to begin another cycle.

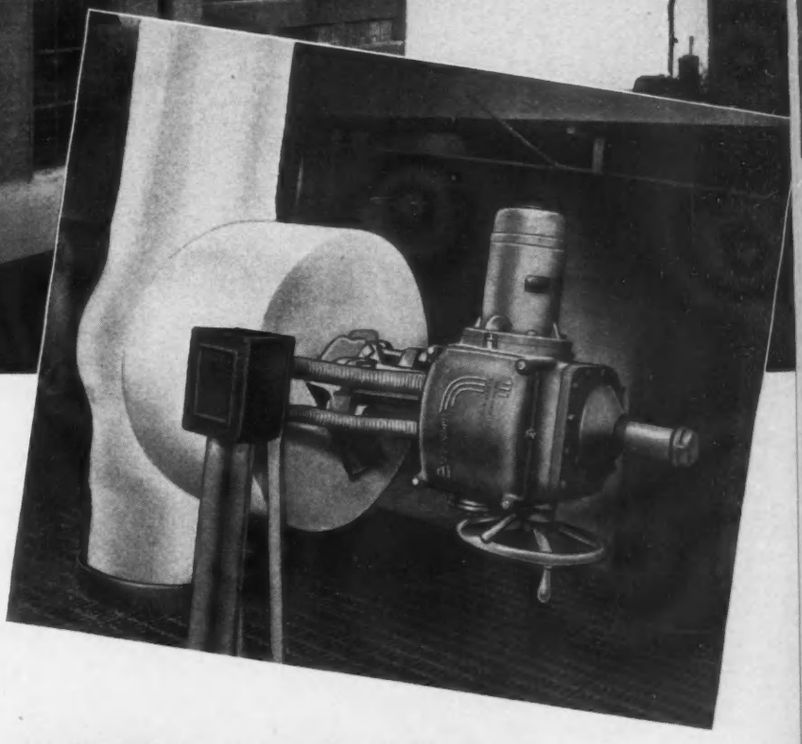
The machine, installed at the Cleveland Tractor Company, can be adapted to many different types of heat-treating jobs, with changes in the design of the inductors.

HIGH-FREQUENCY INDUCTORS heat sprocket teeth for hardening

N POWER PLANTS
HERE WAR PRODUCTION BEGINS



In the new Venice No. 2 Plant of the Union Electric Co. a number of Limitorque Controls have been installed for valve operation. One of these is shown below.



IMITORQUE CONTROLS
MPLIFY VALVE OPERATION

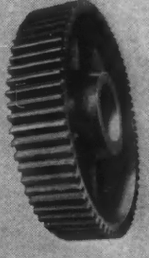
plying the power to turn out weapons for victory is a big part of the job ower Plants today. Hard pressed to meet all demands, the simplification speeding up of routine operations in the plant is vital. A step in the right ction is the installation of LimiTorque Controls on all types of valves from o 96" diameter. With LimiTorque, valves can be opened or closed surely quickly by just pushing a button at a conveniently located individual ion or from a master control panel. Whether for new installations or for ring better control in existing stations—investigate LimiTorque. It can be d to your present equipment. Write us for further details.

PHILADELPHIA GEAR WORKS

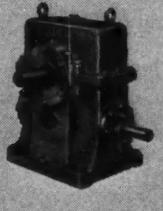
INDUSTRIAL GEARS
AND SPEED REDUCERS
TORQUE VALVE CONTROLS

ERIE AVENUE & G STREET
PHILADELPHIA, PA.
New York, Pittsburgh, Chicago

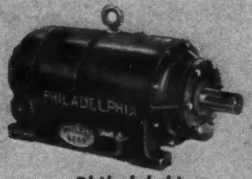
Philadelphia
LIMITORQUE CONTROL
perates all types of valves, etc., afely, economically, from convenient stations.



Philadelphia
GEARS
All types and sizes of industrial gears. Can be supplied in all materials.



Philadelphia
WORM GEAR SPEED REDUCER
right angle drives—vertical or horizontal. Wide range of ratios and horsepowers.



Philadelphia
MOTOREDUCER
The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.

Philadelphia
HERRINGBONE SPEED REDUCER
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

NEW EQUIPMENT

Portable Instruments

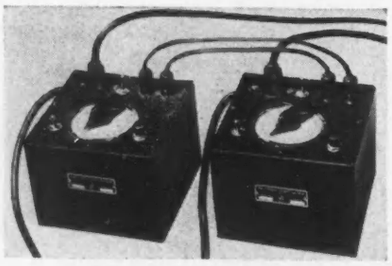
The "P-14" embodies a variety of single- and multi-ranges providing for the measurement of a.c. volts, amperes and milliamperes; d.c. volts, amperes, milliamperes and micro-amperes. Combinations such as four current and three voltage ranges are claimed to make this the most complete and flexible instrument available in this classification.

"P-14" a.c. and d.c. instruments for general field service use. **Westinghouse Electric & Manufacturing Co.**, East Pittsburgh, Pa.

•

Timers

Designed for single actuation as well as for sequence timing and recycling in continuous operation, these timers for 105-122-volt, 50-60-cycle, a.c., are especially useful where short timing periods are required which have to be accurately controlled. Powered load outlet and unpowered load terminals are usable simultaneously and are adjustable independently for "normally opened" and normally closed. Remote control socket and sequencing outlet.



Two "Model 900" electronic timers; connected for recycling. **Photovolt Corp.**, 95 Madison Ave., New York, N. Y.

•

Cleaning Compound

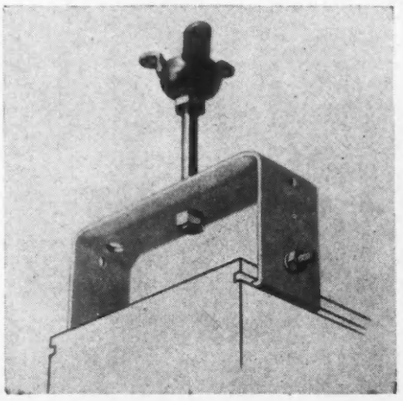
"Elektro-Purjit" cleaning compound. **Trojan Products & Manufacturing Co.**, 3130 S. Wabash Ave., Chicago, Ill.

Non-inflammable, fused chemical compound for cleaning machinery instantly dissolves rust, grease and weather corrosion on glass and effectively cleans oily cement and wood floors. Also a disinfectant, the compound will not harm porcelain and enamel surfaces, it is claimed.

•

Mounting Device

Adaptable, flexible mounting clamps, designed to provide fast installation and easier maintenance of Sylvania fluorescent fixtures. After clamps are mounted, fixtures may be lifted, section by section, and snapped into place. The new device offers a variety of applications for chain, surface, rod or messenger-cable mounting.

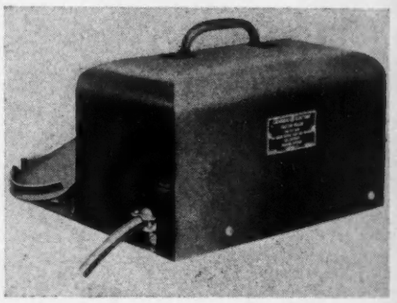


"Slide-Grip" hangers for use with Sylvania continuous-flow fluorescent fixtures. **Sylvania Electric Products, Inc.**, Ipswich, Mass.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Crater Filler

New crater filler, designed for use with the G-E Strikeasy welder. Combination of a foot-operated rheostat for reducing the current and a field-forcing switch for providing a hot start or an increase in welding current provides close auxiliary control of heat for welding thin material and permits tapering off of the current at the end of a bead to fill the crater.

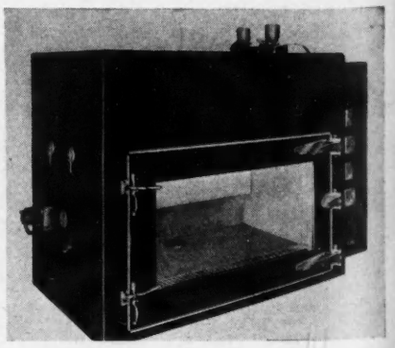


G-E crater filler. **General Electric Company**, Schenectady, N. Y.

•

Testing Chamber

For testing instruments, chamber with self-contained refrigeration and heating equipment has a range of operating temperatures from minus 55 deg. C. to plus 70 deg. C. Entire operation is completely controlled from a front panelboard. Observation of instruments being tested is provided by a glass, steel-framed door. Cabinet contains 6 in. of fiberglas insulation.



Model "RTC-1" provides air circulation in 28.7-cu.ft. chamber. **American Coils, Inc.**, Newark, N. J.

SILHOUETTES
in the night

Two silhouettes against the glowing sky, so similar in appearance and purpose, yet so vastly different in character.

The one is a factory, with chimneys belching smoke and fire, evidence of the productive energy beneath, working night and day to feed the cannons of our fighters.

Much more difficult a task, with many lives held in the balance, is that of the men behind the gun. Every flash, every rumble echoes a unity of purpose supported by the greatest single group in the history of the world. One object! Simply stated, but of colossal import. "Win the war!"

Two silhouettes against the sky. One is a symbol of the country's productive effort of which you and we are a part. We are pleased to place our facilities completely at the disposal of our government. We are proud that it is in our power to help the boys whose forms are outlined in that other silhouette.

"HANG THE LOAD ON HUBBARD HARDWARE"

HUBBARD AND COMPANY

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ORANGEBURG *Underground Suggestions*

. . . need standard or special bends *in a hurry?*

here's a practical suggestion from General Construction Foreman "X"

WE recently received a letter from John "X"—a well-known general construction foreman of a utility in the mid-west.

Although we cannot reveal his name, we have his permission to publish his letter. Here it is . . .

"When we need special or intricate conduit bends in a hurry—faster than we know it is possible to get them—we take straight lengths of Orangeburg from stock, and move them down to our power plant.

"We then take a length of flexible metallic tubing of a diameter slightly smaller than the I.D. of the Orangeburg and slide the tubing into the conduit.

"The 'open' end of the conduit is then closed with a tapered wooden plug, and the other end is caulked around the flexible metal tubing.

"Then steam is admitted to the tubing. In a very short time the Orangeburg Conduit is 'warm', and is easily bent to the desired radius and angle.

"The bend is then embedded in sand to hold it in shape while cooling. This method is fast—a crew of two of my men have made twenty bends in one hour."

If you want complete information on Orangeburg Conduit—what it is, how to use it, what it does, how it saves time, trouble and cable—then send for Catalog 42-E. A copy will be sent without cost or obligation.

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10-FC-2

NEWS ABOUT PEOPLE

Civil Engineers Elect E. B. Whitman President

Ezra B. Whitman, consulting engineer of Baltimore, Md., was recently elected president of the American Society of Civil Engineers.

A graduate of Cornell University,

Greystone Studios, Inc.

Mr. Whitman has engaged in consulting engineering work in Baltimore since 1902 and has been a member of the firm of Whitman, Requardt & Smith since 1925. He has devoted special attention to sewerage and water-supply work, serving the city of Baltimore as water engineer and president of its water board from 1906 to 1914. He was identified with the Public Service Commission of Maryland from 1921 to 1927, serving as chairman in 1925. From 1933–34 he was chief engineer of the West Penn Electric Co. At the present time he is chairman of the Maryland State Roads Commission.

Mr. Whitman is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and of the American Institute of Consulting Engineers.

•

▶ C. F. POIRIER, who has been functioning as vice-president of the Crocker-Wheeler Co., Ampere, N. J., has received an indefinite leave of absence to serve in the capacity of electrical consultant to the shipbuilding division of WPB. His principal duties will consist of analyzing productive capacity in the electrical industry and making recommendations with respect to whether existing electrical manufacturing facilities are sufficient to serve the nation's vast shipbuilding program. Mr. Poirier has been closely associated with the electrical industry for the past 20 years, with Crocker-Wheeler and other units within the industry. In addition, he has been a member of WPB advisory committee for the electric motor and generator industry for the past several months.

•

T. W. Crockett Assumes New Executive Duties

Tom W. Crockett has been elected a vice-president of Mississippi Power & Light Co., Jackson, Miss. Mr. Crockett, who is division manager of the central

division, will continue to serve in that capacity in addition to his new responsibilities as a vice-president.

K. L. Hansen New President of Welding Society

K. L. Hansen, who was elected president of the American Welding Society at the recent meeting in Cleveland, Ohio (ELECTRICAL WORLD, October 24, page 10), is consulting electrical engi-

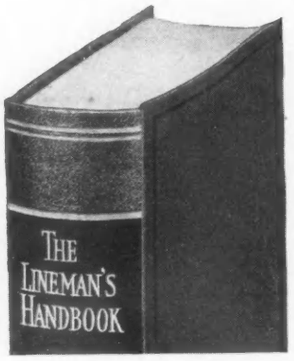
neer for the Harnischfeger Corp., Milwaukee.

Born in Norway, Mr. Hansen came to this country at an early age and attended the University of Illinois. He entered the employ of the Westinghouse Electric & Manufacturing Co. in 1912 and from 1913 to 1919 he served as design engineer, direct-current apparatus. Subsequently he became design engineer for the Mechanical Appliance Co. (now the Louis Allis Co.) on d.c. and a.c. apparatus, and later was made chief engineer of that organization. He has been consulting engineer for Harnischfeger Corp. since 1932.

Mr. Hansen has patents on a number of arc-welding processes and is the author of many articles on that subject. He is a vice-president and a fellow of the American Institute of Electrical Engineers and has been active in committee work for that society for a number of years.

That transmission line fact you want is HERE . . .

No matter what is may be, you will find complete data in this practical handbook for linemen, foremen, and other employees of line departments. This big home-study and reference volume is filled with the facts you need in order to do quick, safe, efficient work. Do you want to brush up on electrical fundamentals? Are you looking for information on electrical systems in general? Do you want standard procedures, the methods crack linemen follow, the descriptions, directions, and data to help you overcome problems in construction and maintenance? You will find them all in this meaty volume.



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The LINEMAN'S HANDBOOK

Revised, enlarged, up-to-date 2nd edition

By EDWIN KURTZ

Professor of Electrical Engineering and Head of Department, State University of Iowa, formerly Member of the Educational Department, The Milwaukee Electrical Railway and Light Co.

652 pages 6 x 9, 682 illustrations, $4.00

This book is a great manual of principles, data, methods and cautions on all aspects of the lineman's work. Everything is covered, from the elements of electricity to maintenance of lines, and first aid work. The writing is clear, simple, understandable. The treatment is complete, descriptive of everything you want to know, backed up with many illustrations, tables, diagrams, charts, and other explanatory and reference aids.

Use it as thousands of other line department workers have—to check your methods against the practice of others, to get quick, dependable answers to problems that arise on the job, to brush up on special points, and for consistent study to improve your knowledge, grade, and earnings.

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9. Pole-line Erection
10. Tower-line Erection
11. Inspection, Testing, and Maintenance
12. Rural Lines
13. REA Manual of Operation and Maintenance
14. Safety Methods in Construction of Overhead Lines
15. Pole-top Resuscitation
16. First Aid Talks
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682 ILLUSTRATIONS

many showing complete, step-by-step sequences of work, are on important feature in making this book practical, easy to use and to understand.

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▶ THOMAS INGLEDOW, chief engineer of the B. C. Electric Railway Co., Ltd., has been elected chairman of the Vancouver section of the American Institute of Electrical Engineers for the 1942-43 term.

▶ JULIAN B. TURNER has been appointed by the Federal Power Commission as its director of personnel. Mr. Turner succeeds Horace M. Thomas, who was recently appointed administrator of the commission's regional office in Chicago. For the past eight months Mr. Turner has been with the Civil Service Commission.

▶ WENDELL J. WRIGHT, general counsel of Public Service Corp. of New Jersey and subsidiary companies since 1933, has been elected a member of the board of directors of Public Service Corp. and of its executive committee, succeeding Edward C. Rose, now in military service.

▶ KENNETH R. MACCLURE, for the past eleven years safety engineer of the Moncton Electricity & Gas Co., Moncton, New Brunswick, has been given an indefinite leave of absence to join a shipbuilding company at St. John in the same capacity. Mr. MacClure became associated with the Moncton utility in 1929 as a draftsman and was appointed safety engineer two years later.

▶ RUSSELL C. CRAVENS, statistical engineering department, Kansas City Power & Light Co., Kansas City, Mo., has been made head of a new department organized to co-ordinate the engineering, operating and accounting requirements of property records. A nucleus for the work of the new department will come from work already done or now in progress by the statistical engineering department.

▶ JAMES S. HAGAN of La Grange, Ill., has been appointed manager of the northwestern district of the Westinghouse Electric & Manufacturing Co.'s district manufacturing and repair department. He succeeds R. E. Powers, now serving as Pacific Coast district manager of the department. In his new position Mr. Hagan will supervise repair and manufacturing activities in a territory that embraces all or parts of nine states. He joined Westinghouse student course in 1916 and the following year was assigned to the railway section of the general engineering department. Following the World War he returned to Westinghouse and in 1922 was sent to Java in the Dutch East Indies in connection with the electrification of a railroad. After an association with the Baltimore & Ohio and Central Railroad of New Jersey, he joined Thomas A. Edison, Inc., as western railway sales manager, Edison storage battery divi-

sion, the position he occupied until rejoining Westinghouse recently.

▶N. S. HIBSHMAN, formerly associate professor of electrical engineering, Lehigh University, Bethlehem, Pa., has been appointed head of the department of electrical engineering at New York University. He is a fellow of the American Institute of Electrical Engineers and has served as vice-president of that society, representing the middle eastern district.

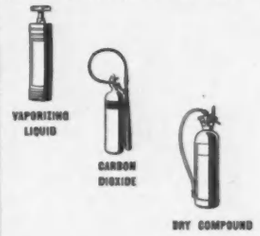
▶COL. JOHN STILWELL has been elected to serve a three-year term on the board of directors of the American Standards Association. Colonel Stilwell is serving his third term as president of the National Safety Council. He has also served as president of the Greater New York Safety Council. He has for many years been interested in the development of safety standards as a means of preventing accidents. He was a member of the safety code correlating committee of the American Standards Association in the early days of safety standardization work. As general superintendent of transportation and later vice-president of Consolidated Edison Co. of New York, Colonel Stilwell has had a good deal to do with the safety program of that company.

▶C. GIRARD DAVIDSON has been appointed general counsel of the Bonneville Power Administration to succeed C. ALLAN HART, who has entered military service. For the past two years Mr. Davidson has been assistant general counsel. Prior to joining the Bonneville staff Mr. Davidson was attorney with the Tennessee Valley Authority, and later, after a period of general practice in Louisiana, became consultant in the legal division of the U. S. Housing Authority, during which time he organized the utilities section and handled commission rulings and utility contracts for housing projects. During his tenure at Bonneville he also served as chief consultant to the legal division of WPB, assigned to the power, gas and water branch. In this capacity he assisted the WPB in handling the power shortage problem in the southeastern United States.

▶HOWARD COONLEY, chief of the simplification branch, WPB, has been appointed an additional deputy director of the conservation division, because of the rapid expansion of salvage operations. ROBERT B. SHEPARD, whom Mr. Coonley selected last May as his first assistant with the title of deputy chief of the simplification branch, has been made chief of that branch. Mr. Coonley, appointed to WPB in March to co-ordinate and implement the simplification and standardization program, was formerly president of the

FIRE and how to fight it!

IT'S EASY TO REMEMBER THESE FACTS ABOUT FIRE EXTINGUISHERS

	CLASS A FIRES Paper, wood, fabrics, rubber, shavings, etc.	CLASS B FIRES Flammable liquids, greases, etc.	CLASS C FIRES Electrical Equipment.
HOW TO FIGHT THEM	 Quench and cool this type of blaze with water or extinguishing agents containing large percentages of water.	 Blanket this type of fire. Cut off oxygen supply, thus preventing combustion.	 Blanketing or smothering is essential. *Use extinguishing agent which is a non-conductor of electricity.*
USE THESE EXTINGUISHERS			
IN THIS WAY	 Aim at base of fire. When fire seems extinguished, look carefully for signs of glowing embers and quench them.	 If outdoors, keep wind at your back. If flowing fire, work "upstream." On 2-level fire, work from bottom up.	 Shut off electrical current, if possible. Don't stand in puddles or wet places while using extinguisher.

DON'T DO THESE THINGS

Don't ever forget that portable fire extinguishers are for small, incipient fires. And don't tackle too big a blaze with hand extinguishers.

Don't fail to turn in fire alarm if there is the slightest question about your ability to handle the fire.

Don't disobey fire-fighting rules.

Don't use a water stream on electrical fires or on Class B blazes; it may make things tragically worse.

Don't use extinguishing equipment that is not "approved by Underwriters Laboratories," or by Factory Mutual Laboratories as indicated by this symbol. FM

GET THIS CHART FREE!

Fire-fighting equipment has a war job now. This means, simply, that most plants have to get along with present supplies of extinguishers for the duration. Therefore, Walter Kidde & Company presents this chart—to make fire-fighting more effective. If key workers understand facts about extinguishing, your Kidde* extinguishers and other equipment will kill fires faster, cut losses.

If you want reprints of this chart for your personnel, write to

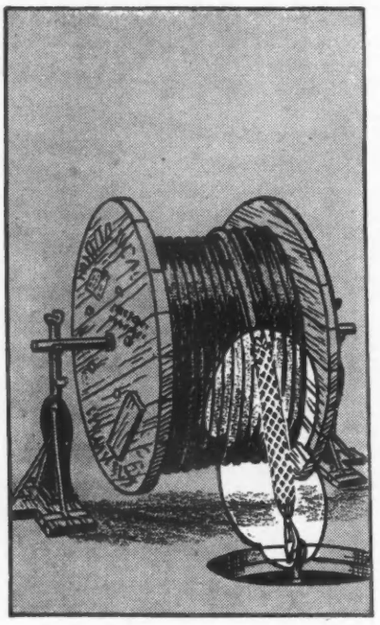
Walter Kidde & Company, Inc., 1047 West St., Bloomfield, N. J.

Kidde

*Formerly known as "LUX" extinguishers

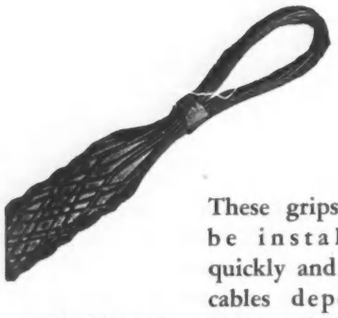
SPEED

CONSTRUCTION and EXPANSION of PLANT FACILITIES



RELIABLE CABLE GRIPS

For Pulling in Wires and Cable



These grips can be installed quickly and pull cables dependably. They do not let go halfway through a duct because the wires pull with evenly distributed load. Eight different styles — all supplied in a full range of sizes.

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OVER 30 YEARS SERVICE TO THE UTILITIES
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National Association of Manufacturers and of the American Standards Association. He obtained leave of absence from his duties as chairman of the board of the Walworth Company to go to Washington. Mr. Shepard, at the time of his appointment to WPB, was chief electrical engineer of the Underwriters' Laboratories, Inc.

▶ SELDEN H. GORHAM has been appointed manager of dealer sales of the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Mr. Gorham has been identified with the Allis-Chalmers sales organization since 1933, his initial position having been with the Detroit district office as a representative of the feedwater treating department. For the past six years he has been in charge of sales and production for that department. As head of dealer sales, he succeeds STANLEY J. RETZLAFF, who has taken over the company's trade relations department.

▶ K. R. VAN TASSEL has been appointed manager sales of the newly formed integral-horsepower motor section of the General Electric Co.'s motor division. D. A. YATES, of the same division, has been placed in charge of the Lynn motor group at General Electric's Lynn, Mass., plant. Mr. Van Tassel has been connected with G.E. since 1925 and has been manager sales of Lynn motors since 1940. Mr. Yates became associated with G.E. in 1930.

▶ EDWIN A. NICKEL, advertising and sales promotion manager of the Mitchell Manufacturing Co., Chicago, has been appointed sales manager of the company. Mr. Nickel has a background of 23 years experience in sales work. In his new position he will continue to handle advertising, but will devote his major attention to the sales end of the company's business.

▶ JOHN SARANO, who has held an important place in the development of power in Nassau County, Long Island, has retired. He began work for the Roslyn Light & Power Co., Roslyn, L. I., in 1902 and prior to this connection he had had a number of years' experience in the installation of electric power facilities elsewhere in New York State. Shortly after he began his work in Roslyn the utility name was changed to Nassau Light & Power Co. and within the next few years additional properties were acquired. In 1922 the Nassau Light & Power Co. was taken over by the Long Island Lighting Co. and Mr. Sarano continued as operating manager in Nassau County. At the time of his retirement he was holding the position of electric operating manager in charge of all electric plants and electric transmission and distribution lines of the company.

ELECTRICAL SPECIALTIES FOR HEAVY DUTY POWER SERVICE

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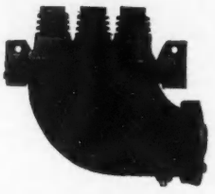

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OBITUARY

Frank R. Phillips

Frank R. Phillips, chairman of the board of the Philadelphia Company and subsidiary companies, died on October 23 at his summer home at Valley Forge, Pa., after a short illness following an operation. He was 65 years of age. Mr. Phillips retired from the presidency of the Philadelphia Company in January, 1942, following more than 32 years of service with the company.

•

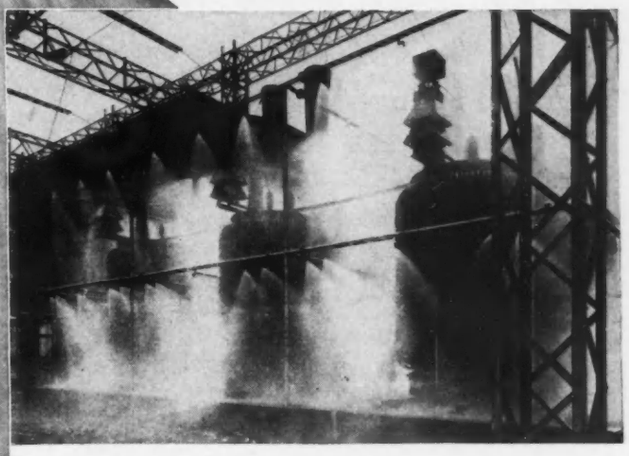
▶ JOHN S. MARTIN, 54, a member of the Peabody (Mass.) municipal electric light commission, died at Brookline, Mass. October 13.

▶ WADE H. JOHNS, who was commercial manager for the Public Service Electric & Gas Co., Newark, N. J., at New Brunswick for many years, died on September 25 in Hartford, Conn., where he had gone to recuperate from a heart ailment. He was 68 years of age. Mr. Johns had been with Public Service since 1914.

▶ S. B. ANDERSON, 67, assistant treasurer and assistant secretary of the General Electric Supply Co., died in San Francisco on September 21. He had been in the hospital for two weeks following a heart attack. Mr. Anderson was born in Sweden and came to the United States with his parents when he was a boy. The family settled in Chicago and Mr. Anderson moved to San Francisco as a young man. He became associated with the Pacific States Electric Co. and was secretary-treasurer when that company was taken over by G. E. Supply Co. in 1929. As assistant treasurer and assistant secretary for the supply company, he was in charge of that phase of the business on the Pacific coast.

▶ JAMES R. MCKEE, formerly executive vice-president of the General Electric Co., and son-in-law of President Benjamin Harrison, died suddenly at his home in Greenwich, Conn., on October 21. He was 84 years of age. A pioneer in the electrical industry, Mr. McKee joined the Thomson-Van Der Poel Electric Mining Co. as president at the time of its organization. He was also manager of the Thomson Houston Motor Co. and these activities in 1890 and 1891 resulted in his being made manager of the power and mining department of the General Electric Co. when it was organized in 1893. He was appointed chairman of the company's sales committee in 1908, and four years later was elected to a vice-presidency. Mr. McKee retired in 1913.

POSITIVE PROTECTION for Oil-Filled Equipment



STOPS OIL FIRES WITHOUT CHEMICALS!

Permanently installed on transformers or other oil-filled equipment, a Grinnell Mulsifyre System will stop oil fires so fast that outages seldom result!

The instant a Mulsifyre System is turned on (either manually or automatically), high-velocity sprays of water blanket the oil... churn the surface into a non-flammable emulsion . . . stop fire in 2 to 5 seconds. There's no time for major damage . . . no chemical to corrode equipment.

INVESTIGATE this simple, sure oil fire protection. Write for authoritative Data Book on Mulsifyre Systems by Underwriter's Laboratories. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of U. S. and Canada.

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MANUFACTURING-MARKETS

Turbine Production Increases 109%

Production of propulsion equipment for naval vessels and turbines for land power houses at the Westinghouse steam division, South Philadelphia, Pa., has more than doubled in the last ten months, as compared with the ten months preceding Pearl Harbor. In the ten months preceding Pearl Harbor, deliveries made by the steam division amounted to $23,998,000. In the ten months since Pearl Harbor, deliveries totaled $50,356,000, an increase of 109 percent.

In virtually the same period, Mr. Robertson pointed out, Westinghouse has built, equipped and put into operation the $26,000,000 merchant marine division plant.

Westinghouse will produce this year more than $500,000,000 worth of equipment. L. E. Osborne, vice-president in charge of the steam division, has reported that the steam division this year would deliver nearly $70,000,000 worth of equipment, approximately four times normal peacetime annual production.

Ellis L. Spray, manager of the new merchant marine division, disclosed that the new plant soon will deliver at least four months ahead of schedule its first complete ship propulsion unit, consisting of high pressure turbine, low pressure turbine and driving gears. Four months after this delivery, production will reach contract capacity, although construction and tooling of the 14-acre plant will not be completed until next spring.

•

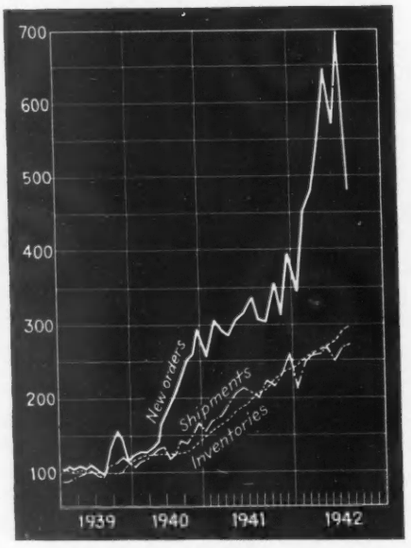
Westinghouse Renames Merchandising Unit

The merchandising division of the Westinghouse Electric & Manufacturing Co. has been renamed the electric appliance division, J. H. Ashbaugh, manager, has announced. The change has been made because the new name better indicates the manufacturing facilities at both the Mansfield, Ohio, and Springfield, Mass., plants.

•

Electric Machinery Indices Advance

Following the general decline from the high totals recorded for new orders during the first half of the year, the index of value of electrical machinery orders dropped to 474 in August from 699 in July, according to the figures compiled by the Bureau of Foreign and Domestic Commerce. This compares with 309 in August, 1941.



ELECTRICAL MACHINERY INDICES of Bureau of Foreign and Domestic Commerce

Electrical machinery inventories continued to advance, rising to 298.8 in August from 290.3 in July—August, last year 206.5.

Shipments in August advanced at a retarded rate to 270 from 267 in July; August, last year 201.

Sees Lasting Value in War Research

Much of the scientific effort now being devoted to war will have lasting value, declared Dr. William D. Coolidge, General Electric vice-president and director of research, in a Founder's Day address delivered at Ursinus College, Collegeville, Pa., on October 13.

"Today we see the majority of the scientists of the world, both university and industrial alike, recruited for use in war," said Dr. Coolidge, "and we see science playing so vital a role that it may win or lose the struggle.

"A tremendous contribution to the war effort is being made by our colleges not only through the activity of their scientific staffs in developing important new materials and new devices but also through the use of their teaching facilities. The importance of this last can hardly be overestimated, for we must not only have the necessary new mechanisms of warfare but we must also have an adequate number of people conversant with their use and their maintenance; and the essential basic training for these people is best given in the colleges.

"While the necessity for the scientific effort involved represents in magnitude the greatest tragedy which civilization has ever encountered, much of it will have lasting value, and in many important lines research is being prosecuted at a rate which would be quite out of the question in peacetime. . . ."

•

Cornell-Dubilier Opens New Capacitor Plant

Opening of a fourth large plant, announced by Cornell-Dubilier Electric Corp., South Plainfield, N. J., will bring the company's output of capacitors to new high levels, in step with steadily increasing wartime demands.

This expansion, completed entirely

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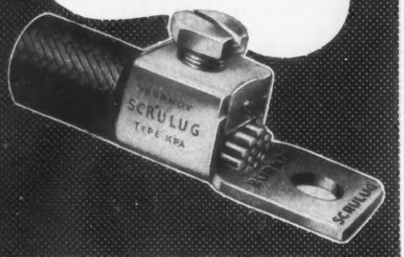

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INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

by company financing, is expected to relieve some of the pressure under which the other three production units have been working in an effort to supply the needs of industry and the armed forces. The new plant was equipped, staffed and placed in operation in record time, according to the company's president, Octave Blake.

•

Manufacturers Issue Earnings Reports

Rome Cable Corp. for the quarter ended September 30 reports net profit of $51,620, equal to 27 cents each on 189,830 capital shares against $65,898, or 34 cents a share in the preceding quarter and $121,648 or 64 cents a share in the third quarter of 1941. For the six months to September 30 net profit amounted to $117,518, or 61 cents a common share, against $242,382 or $1.28 a common share for 1941 period.

ACME STEEL—Third quarter, including subsidiaries, net profit $354,460 after provision of $868,979 for Federal income and excess profits taxes, equal to $1.08 a share on 328,108 shares of capital stock. Net profit for previous quarter, $380,285, or $1.16 a share, after Federal tax charges of $1,049,753 and for the third quarter of 1941, it was $761,154, or $2.32 a share, after providing $1,294,742 for Federal income and excess profits taxes. For the twelve months ended with September, net profit $2,000,489, or $6.09 a share, against $2,865,850, or $8.73 a share, for the twelve months to September 30, 1941.

•

Essex Wire Corp. to Build New California Plant

Essex Wire Corp. of California, a subsidiary of the parent Detroit company, has acquired land and buildings in a central location in southern California, for the purpose of establishing wire manufacturing facilities to serve the Pacific Coast area. An investment in excess of $500,000 is involved.

The factory will be equipped with modern laboratory facilities and machinery for the drawing, annealing, winding, treating and testing of various types of copper wires and cables. The first unit in the new plant is expected to be in operation next week.

•

Appoints Factory Agent

Hart Manufacturing Co., manufacturer of "Diamond H" switches, Hartford, Conn., has appointed Electrical Agencies, 165 Purchase St., Boston, Mass., as factory representative.

Field Reports on Business

As a result of more rigid government restrictions imposed to conserve raw materials, electrical equipment buying is slowing up. A majority of the contracts have already been negotiated on equipment for the large volume of new war plants. Wiring orders continue at a good pace.

NEW YORK

Financial markets remained favorable throughout the week and, in the bond market, averages moved ahead to higher levels to a point that had not been reached since 1937. Stock averages approached 1942 high levels, too.

Department store sales for the week ended October 17 increased 16 percent over the corresponding week a year ago, according to the Federal Reserve Board. New York's increase was below the national average, however, at 6 percent. On a national basis, the increase for the four-week period was 11 percent. Retailers' inventories have failed to show any material decline from the high levels reached earlier this year, available statistics show. The sustained inventory level explains, in part, WPB's order requiring the retail trade to reduce inventories, by next spring, to something like normal levels.

Engineering construction volume for the latest week totals $87,995,000, an increase of 25 percent over the volume for the corresponding week last year, but 44 percent lower than the total for the preceding week, according to *Engineering News-Record*. The current week's construction brings the 1942 volume to $8,221,303,000, an increase of 60 percent over the 43-week period in 1941. Federal work still accounts for the greatest portion of the construction volume.

PACIFIC COAST

The value of building permits for seven western states for September, 1942, totaled $14,349,629, a decrease of 60 percent under September, 1941, and a decrease of 25 percent under August, 1942. Less than 10 percent of California farmer applications for electric power service have been disallowed by the WPB. Northern California Electrical Bureau has combined with the Gas Appliance Society in establishing an advisory service for dealers with war-time problems. Housing continues to be the major construction item.

San Francisco is to recommend a 25,000 kw. addition, costing $2,000,000 to its Hetch-Hetchy system, for which RFC assistance is hoped. Industrial developments include first buildings for Shell's $15,000,000 butadiene synthetic rubber plant at Gardena near Los Angeles; a 1,000-ton mill, costing more than $500,000 to handle lead and zinc ores near Leadville, Colo.; a $1,000,000 addition to Vega Aircraft plant near Burbank; and $2,500,000 additional buildings for Northrop Aircraft Co. in Los Angeles County. Some of these big plants such as Bechtels on North Bay near San Francisco are practically completed, but they will continue to be heavy purchasers of electrical material.

Recent orders in the Bay area, for example, have included $37,000 welding sets and 3½ million pounds of electrode rods, value $250,000. Tacoma is in the market for the power and light switchboards for La Grande powerhouse and received a low bid of $32,000 from Railway & Industrial Engineering Co. for 13.8 kv. bus equipment for its Nisqually project. The Bonneville System, a big buyer of heavy machinery one year ago, has dropped to such purchases as 45 instrument transformers.

CHICAGO

Reports from manufacturers reveal that, on the whole, orders for new electrical equipment have declined rather steadily during the past month. This is particularly true of construction material and operating equipment and due primarily to a decrease in the number of large plants to be constructed. A majority of the contracts have already been negotiated on equipment for the large volume of new war plant construction in this area earlier in the year. In addition, restrictions on all building except for war purposes has further depressed the market for electrical equipment.

As industrial activity continues to mount higher the demand for maintenance and production items is steadily increasing. Motor repair shops are swamped with business and replacements in industrial plants are high as a result of the excessive strain on operating equipment. Wholesalers inventory of appliances is extremely low whereas most of the dealers have enough stock to get by until Christmas. After that the outlook is discouraging. Retail trade is climbing steadily and last week recorded better than average gains.

Last week 83 war orders were placed with 62 companies in this area. Those involving electrical equipment included: Allied Radio Corp., miscellaneous supplies; American Automatic Electric Sales Co., telephone wire; Chicago Flexible Shaft Co., furnaces; Gerhardt Meyne Co., construction contract for electric wiring and motor generators; Wood Electric Construction Co., install airport lighting system in the state of Indiana.

NEW ENGLAND

Electrical equipment buying is slowing up as a result of more rigid government restrictions with regard to the conservation of raw materials. Small motor orders have fallen off; central station equipment purchases are limited to emergency replacements running on an average less than $1,000, and factory expansions have come to a standstill. Government demands continue at a good pace, particularly in the communications, wiring for light, and housing project fields.

Boston Woven Hose & Rubber Co. has been awarded a Navy contract for lining amounting to $760,000. Metropolitan Electric Manufacturing Co., West Warren, Mass., has received an order for part of a 125,000 fuse commitment and a Connecticut manufacturer (Deep River) has sold 400 electric soldering irons. Over one million feet of copper wire is asked for government uses and bids have been submitted by manufacturers in this area. Other items of interest attracting attention are motor-driven suction blowers, ferrule mounted resistors, friction tape, soldering irons, and storage batteries. Distribution type transformers are in great demand, especially 3 to 25 kva. sizes.

Supplies for wiring for light and power in connection with the construction of temporary buildings at a number of Army fields here are moving at a good rate. Army field lighting apparatus, wire and cable, and spot lights have been selling well.

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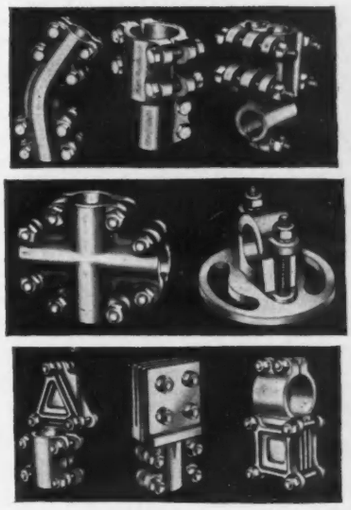

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Sales Opportunities

OREGON—Pacific Power & Light Co., Portland, has authorized immediate expansion and improvements in a hydroelectric power plant including removal downstream, where higher head of water is available, and installation of new 750-kw. hydraulic-turbine generator unit and auxiliary equipment. New transmission lines; also additional distribution lines, with substation facilities. Project has priority rating.

MISSOURI—War Department, Washington, D. C., has approved plans for new air force base in Dunklin County, comprising large group of one and multi-story buildings, with hangars, shops, warehouses and other industrial structures. Complete electrical equipment and facilities will be installed for airfield, residential and industrial service, including underground lines in certain areas. Entire project will cost over $5,000,000, and will be supervised by U. S. District Engineer Office, Memphis, Tenn.

MICHIGAN—Chrysler Corp., 341 Massachusetts Ave., Detroit, has concluded agreement with government for expansion in plant, with installation of machinery for large increased output, including electrical equipment and facilities. Cost over $4,000,000, with financing provided by Defense Plant Corp. Work will be carried out soon.

ILLINOIS—Commonwealth Edison Co., Chicago, plans alterations and improvements in power substation at Evanston. Work will be placed under way at early date.

IOWA—Ogden Superior Coal Co., Ogden, plans rebuilding of power station recently damaged by fire, with loss including engine-generator unit, transformers, switchgear, pumps and auxiliary equipment.

NEBRASKA—War Department, Washington, D. C., has approved plans for new air force base in Redwillow County, including group of one and multi-story buildings, with hangars, shops and other industrial structures. Complete electrical equipment and facilities will be installed. Entire project will cost over $1,000,000 and will be supervised by U. S. District Engineer Office, Davidson Building, Kansas City, Mo.

INDIANA—Studebaker Corp., South Bend, has closed agreement with government for expansion in plants in Indiana and Illinois, with installation of new machinery for large increased capacity, including electrical equipment and facilities. Entire project will represent cost of $6,500,000, with fund in that amount provided by Defense Plant Corp. Work is scheduled to begin at once.

NEBRASKA—Consumers Public Power District, Columbus, plans early construction of transmission lines totaling about 10 miles, with terminal substation facilities, for power supply for federal projects in such areas. Permission has been granted.

COLORADO—War Dept., Washington, D. C., has approved plans for new air force base in Buffalo County, comprising series of buildings, with shops, hangars, warehouses and other industrial structures. Complete electrical equipment and facilities will be installed for airfield, residential and industrial service. Entire project will cost over $3,000,000 and will be supervised by U. S. District Engineer Office, Omaha, Neb.

NEW YORK—E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., manufacturer of industrial chemicals, explosives, etc., has concluded agreement with government for expansion in plant in Niagara County, with installation of machinery for large increase in capacity, including electrical equipment and facilities. Cost estimated over $1,000,000, with financing by Defense Plant Corp. Work will be carried out soon.

INDIANA—Civil Aeronautics Authority, Washington, D. C., has approved plans for new major airport in Wayne County, with hangars, shops and other airfield structures. A complete lighting system will be installed, including range lights, obstruction lights, runway marker lights, underground conduit system, switching station, and complete control apparatus. Appropriation of $900,000 has been approved for project.

IOWA—Iowa Electric Light & Power Co., Cedar Rapids, has approved plans for addition to a steam-electric generating station, 60x116 ft., and 116 ft. high, for expansion in steam department. Work on superstructure will be placed under way at once. Installation will include a new high-pressure boiler unit and auxiliary equipment. Cost estimated close to $250,000.

NEBRASKA—War Department, Washington, D. C., has authorized new air force base in Hall County, comprising group of one and multi-story buildings, with hangars, shops, warehouses and other industrial structures. A power substation will be built, with electrical distribution system for airfield, residential and industrial service. Complete project will cost over $2,000,000 and will be carried out at once. It will be supervised by U. S. District Engineer Office, Omaha.

OREGON—City Council, Salem, has plans maturing for municipal airport expansion, to include hangar, shops and other buildings, with complete lighting system, including range lights, runway marker lights, radio beam, underground conduit system, control station and equipment. A federal grant of $385,000 has been secured for project, with approval of Civil Aeronautics Authority, Washington, D. C.

MICHIGAN—Dow Chemical Co., Midland, has concluded agreement with government for expansion in chemical and processing plant, with installation of machinery for large increased output, including electrical equipment and facilities. Work is scheduled to be carried out at once, with estimated cost of $1,500,000. Fund in that amount will be provided by Defense Plant Corp.

•

Ontario Power Use Up 15.4 Percent

The Ontario Hydro-Electric Commission reports an increase during August of 15.4 percent in the total primary electric power load over the corresponding month a year ago. This increase in power consumption, due to war industries chiefly, was most notable in the Niagara system, where an increase of 276,407 hp. was recorded.

The August, 1941, total peak demand for primary load was 1,841,299 hp., while for August of this year it rose to 2,125,270 hp.

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LETTERS TO THE EDITOR

Street-Lighting Units

[In the October 3 issue we questioned the use of lumens in rating street-lighting lamps because there were too many lumens in any rating and suggested that perhaps some one else had an idea for a unit that did not sound like the national debt. Following are three replies: EDITORS.]

To the Editor of ELECTRICAL WORLD:

In response to your question on street-lighting units, allow me to suggest the term a "Ten-Unit Lamp" (or street light) for a 10,000-lumen lamp.

JACK ADAMS, City Electrician,
Georgetown Water & Light Plant,
Georgetown, Tex.

To the Editor of ELECTRICAL WORLD:

How about "Klumen" for 1,000 lumens?

VERNE W. SHEAR,
Akron, Ohio.

[Not bad, although it does sound like some office in the Ku Klux Klan.—ED.]

To the Editor of ELECTRICAL WORLD:

In reading your recent editorial on the proper rating of lamps, with its query as to a better method, one thought became more and more evident.

Certainly the problem of ratings in general is most confusing to a member of the public. He is likely to smile understandingly when we discuss nameplate ratings, that is, boiler horsepower, brake horsepower, a one-horsepower electric motor, and change to kw., kva. and power factor. He feels we are a mite "tetched" and with good reason. But the 100-watt lamp—that one he has properly ticketed and catalogued! What a pity if it were to be taken from him.

In general, it appears the problem revolves about the point: Shall all equipment be rated at its input in kw., or shall it be rated at its output in whatever terms that may be? The first case is clear. The second case requires that mechanical equipment be rated in mechanical units of work, heating equipment in heating units, illuminating equipment in illuminating units, etc. At the present we have a combination of both methods. Each has its good and bad points and an ideal system would probably incorporate both on each nameplate.

The public's basic understanding of electricity is founded almost entirely on

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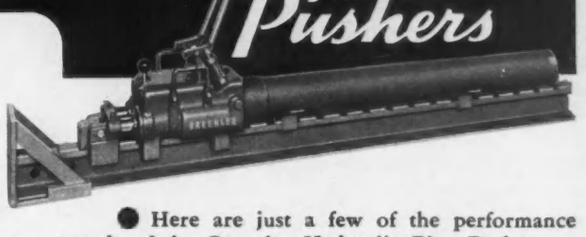

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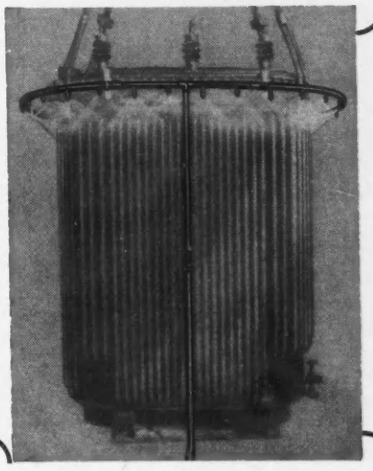

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its cost. This is determined in most cases by kw. and kw.-hr. It follows more or less logically that ratings should be in similar terms, and any change in methods should be to simplify, not confound. While it is agreed the present method does not tell the story, it seems questionable to tell a different story and have it misunderstood as well.

S. D. LONG,
Power and Lighting Engineer
Consumers Power Company,
Cadillac, Mich.

[NOTE—We agree with Mr. Long that this must be very confusing to the public. Are we going to say "Yes, we feel the same way" and do nothing about it? We shall be glad to have comments from readers.—EDITORS.]

•

Salvages 120 Carloads of Steel Turnings

As part of the nation's effort to conserve and reuse all possible war materials, 20 carloads or 4,800,000 pounds of steel turnings have been salvaged in Philco's plants in the first six months of 1942, John Ballantyne, vice-president in charge of operations, has announced.

This scrap, together with large quantities of other scarce materials, has been collected as a result of the company's salvage program and is regularly turned over to the steel industry to be used in the production of new steel.

Other materials salvaged in substantial quantities include 138 tons of brass, 45 tons of aluminum, 126 tons of skeleton steel from the press shops, 330 tons of miscellaneous iron and steel, 210 tons of paper and 6 tons of heavy cardboard cartons.

•

Utah Board Postpones Utility Rate Hearing

Hearing on a state Public Service Commission complaint alleging that rates of the Utah Power & Light Co. are "unjust and unreasonable" has been postponed by the Public Service Commission from October 19 to November 16.

An announcement issued by Charles A. Esser, secretary of the commission, stated that at the hearing "the commission will investigate and determine a just and proper rate base, a fair and reasonable rate of return on such rate base, and such other matters as may bear upon the justness and reasonableness of the defendant's rates, classifications, rules, regulations and practices."

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GRADUATE ENGINEER with seventeen years experience in electric utility construction, valuations, cost analysis, load development, rate design, statistics, general administration, and management problems. Accustomed to responsibility and full charge of work. PW-85, Electrical World, 330 W. 42nd St., New York, N. Y.

BROAD UTILITY BACKGROUND — administration, engineering, accounting, statistics, rates, special problems; 21 years of experience with electric, transportation and combination electric, gas and transportation companies. Especially suited for executive work. PW-86, Electrical World, 330 W. 42nd St., New York, N. Y.

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WANTED

Chief Electrical Engineer

Experienced in design and development of drum type control equipment as applied to heavy material handling machinery. Excellent salary with well established mid-west firm. Please give all details in first reply.

P-59, Electrical World
520 No. Michigan Ave., Chicago, Ill.

POSITION VACANT

Electrical engineer for magnetic and development work. Electrical engineers, metallurgical engineers or physicists may apply. Advanced degree desirable. Previous research or pilot plant experience helpful. Location Pittsburgh. Address

P-78, Electrical World
330 West 42nd St., New York City

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4—100 KVA, G. E. Transformers, V. 33000-2300, 60 cyc.
3—150 KVA, West., V. 2300-115-230-460.
3—200 H.P., West., 900 RPM, 440 V., 60 Cyc. Slip-Ring Motors.
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